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Good Drawings Depend on Good Checking **is the title of an article to appear in March MACHINERY that will appeal to the engineer and designer. This article gives specific directions for checking, to insure that drawings are accurate, completely dimensioned, and easily read. It is based upon instructions issued by a well-known machine-building company.**

April MACHINERY — the Automotive Number — will be eagerly read because it features some of the most recently developed practices in several leading automobile plants in the country, covering ingenious methods applicable in many other branches of the mechanical industries.

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MACHINERY

Volume 42 NEW YORK, FEBRUARY, 1936 Number 6

A Million and a Half Brass Die-Castings Yearly

By CHARLES O. HERB

FIVE or six years ago brass die-castings were being produced in Europe only, and then to a very limited extent. How little was known by American engineers concerning brass die-casting is shown by an article published in an engineering journal at that time, in which the writer deplored the fact that "the most useful non-ferrous alloys, the brasses, cannot be die-cast." However, the advantages that would result from successful brass die-casting were too apparent to engineers and metallurgists to allow the problem to remain unsolved.

Today brass die-casting has spread widely in Europe, and there are several concerns in this country successfully engaged in the new art. One of the pioneers of brass die-casting in this country—the Titan Metal Mfg. Co., Bellefonte, Pa.—now produces between 100,000 and 150,000 brass die-castings per month, operating five days a week, eight hours a day. Approximately 300,000 pounds of brass die-castings are produced by this concern annually. Polak hydro-mechanical machines, which are built in Prague, Czechoslovakia, are used.

The Titan Metal Mfg. Co. is particularly well fitted to give an unbiased opinion concerning the merits and applications of brass die-castings, since the business of this concern consists of melting raw materials and producing die-castings, forgings, and brass rods directly from the raw materials. The principal advantages of brass die-castings over sand castings are better appearance; greater strength; more uniform cross-sections, due to less likelihood of blow-holes; and more economical production when sufficiently large quantities are required. In addition, die-castings generally do not require so much machine work as sand castings.

Die-casting has not yet been applied by this concern, however, for the production of parts weighing more than 4 pounds, although the largest machine in the plant has a capacity for producing

The Experimental Stage of Brass Die-Casting is a Thing of the Past—This Article Describes How Parts are Being Die-Cast in Brass in Large Quantities, and Compares the Advantages of Brass Die-Castings with those of Sand Castings and Forgings

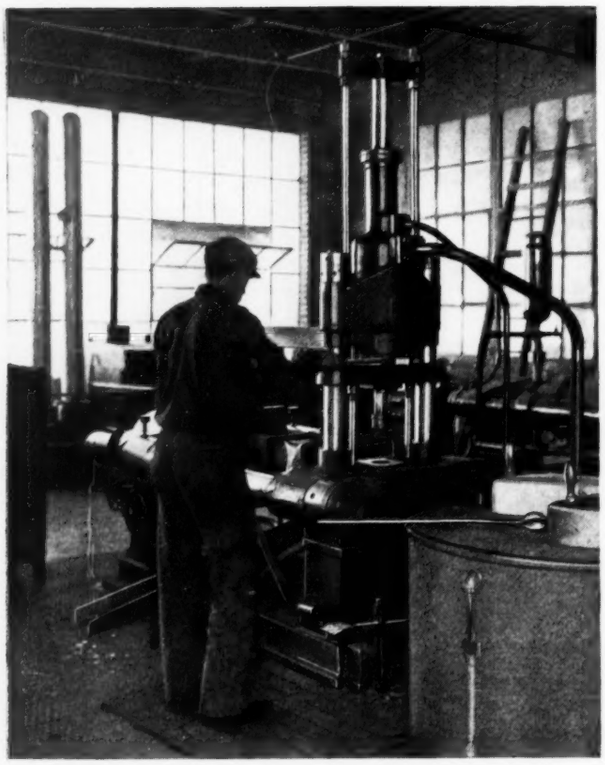


Fig. 1. This Machine Exerts a Pressure of 9800 Pounds per Square Inch in Forcing Plastic Brass into Dies for the Production of Die-castings

parts weighing up to 11 pounds. Defective scrap in sand casting generally runs between 10 and 15 per cent, whereas in die-casting, the defective scrap loss ranges between 7 and 10 per cent, and it can be readily reclaimed by merely remelting.

Brass die-castings can generally be produced cheaper from the virgin metal than brass forgings. With die-casting, only a melting furnace, a die-casting machine, dies, and equipment for producing the required pressure are needed. On the other hand, to produce brass forgings, equipment is required for casting ingots, sawing the ingots into billets, heating the billets, extruding rods, sawing the rods into slugs, heating the slugs, and forging the slugs into the desired parts.

Another great advantage of brass die-castings in comparison with forgings is that holes can be cored with comparative ease. Also, brass die-castings have been produced with sections as thin as 0.030 inch, which would be impossible in forging practice. Die-castings can be produced to knife-edges and with sharp corners.

Brass die-castings, however, cannot be produced with the same density as forgings, and the die-cast metal is porous to some extent. Hence, the concern suggests that die-castings should not be used when water, gas, or air is to be conducted through them under extra high pressures. The defective scrap loss in forging practice is much less than in brass die-casting, being only from 3 to 5 per cent.

While the external surfaces of brass die-castings are much smoother than those of sand castings, heat check-marks develop on the dies with the production of thousands of castings, and therefore brass die-castings are generally not smooth enough to permit satisfactory chromium plating without first tumbling, grinding, and buffing. Brass die-castings have been found especially suitable for use as fittings for piping intended for handling either liquids or gas; for marine fittings; for hardware; for many machine parts; and for many other applications.

In the development of brass die-casting, the principal difficulty to be overcome was that of the short

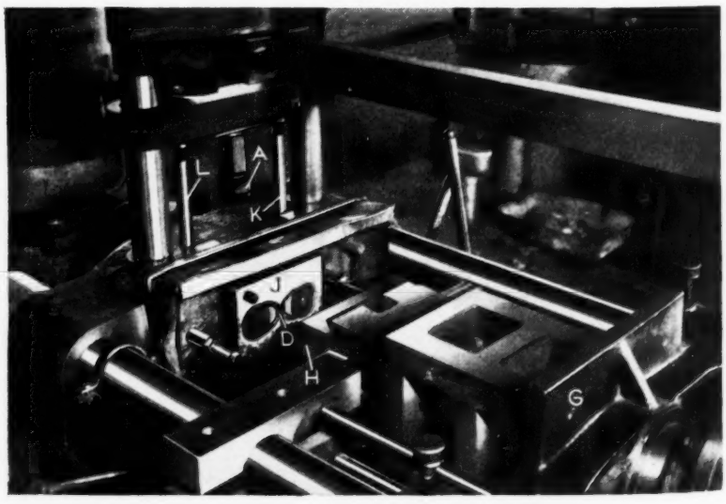


Fig. 2. The Dies in this Machine Simultaneously Produce Two Brass Disks 4 Inches in Diameter and Only 0.063 Inch Thick

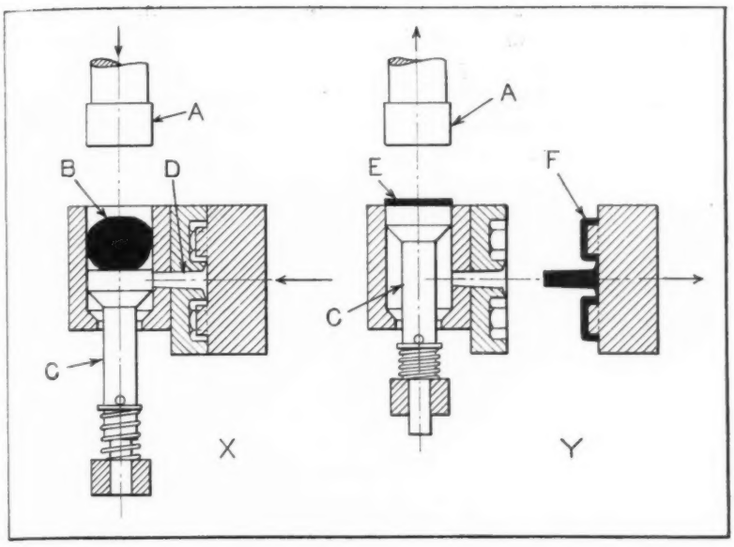


Fig. 3. Diagrams Illustrating the Action of Polak Machines in Pressing Die-castings from Copper-base Alloys in the Plastic State

die life, due to the comparatively high melting point of the metal being cast. The alloys mainly cast by the Titan Metal Mfg. Co., as pointed out in an article published in July, 1934, MACHINERY, have melting points between 1650 and 1675 degrees F. At such high temperatures, the best of alloy die steels are not likely to last long, unless provisions are made to keep the dies from becoming too hot.

Polak die-casting machines are designed on the principle of casting the metal while it is in a semi-liquid or plastic condition rather than in the completely molten state. This allows the metal to be cast at a temperature several hundred degrees lower than when it is shot into the dies in liquid form. In addition, cold water is constantly circulated through plates in back of the die faces to prevent them from becoming heated beyond 600 degrees F. Cold water could not be used directly in the dies for this purpose, as it would cause them to crack.

The die-casting department of this concern has eight Polak machines, as may be seen from Fig. 5. The heading illustration, as well as Figs. 1 and 2, show close-up views of the largest of these machines, which develops a pressure of 9800 pounds per square inch on the 3-inch ram. Adjacent to this machine is an electric furnace which is maintained at a temperature as high as 1900 degrees F. to keep the metal at the desired plasticity. The metal is ladled from the melting pot to the compression chamber of the machine, as shown in the heading illustration. Ladles of different sizes are used, slightly more metal being poured into the compression chamber than is required for each casting operation. The surplus metal is ejected in the form of a slug which is remelted and used again.

Prior to emptying a charge of plastic metal into the machine, the operator moves a long lever at his left which actuates a valve that closes the movable die against the stationary member and holds it in this position for the operation. The moving and clamping of the movable die are effected un-

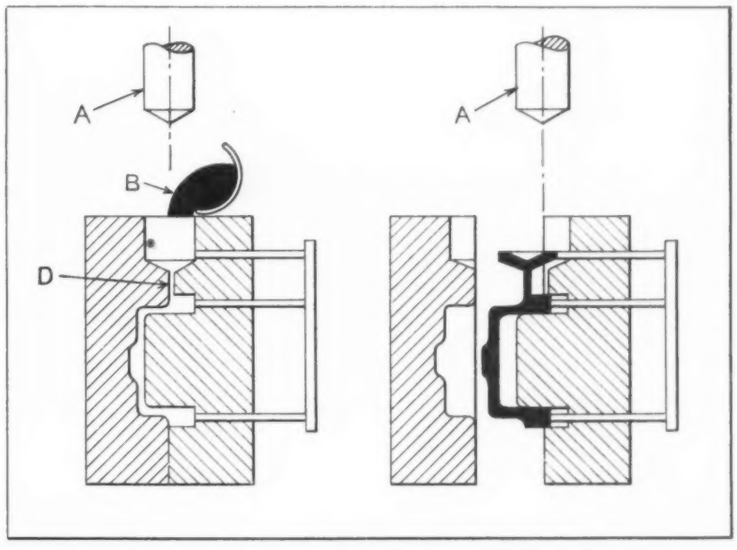


Fig. 4. Diagrams Showing a Recent Development in Brass Die-casting, the Compression Chamber being in the Dies

der a hydraulic pressure amounting to about 120 tons on the large machine. After the dies have been closed and the plastic metal emptied into the compression chamber, the operator depresses a foot-pedal, which causes the hydraulically actuated ram *A*, Fig. 2, to descend into the compression chamber.

The action of the ram is illustrated diagrammatically in Fig. 3. It will be seen that when the plastic metal *B* is emptied into the compression chamber, it drops on top of a spring-backed ejector plunger *C*. When the ram descends, it pushes both the charge of metal and ejector *C* downward until the opening in gate *D* is exposed. The plastic metal is then forced through this gate and into the die cavities. When both the die cavities and the gate have been solidly filled with metal, the ram *A* returns to its upper position.

Simultaneously with the upward movement of ram *A*, ejector *C* is pulled upward, as indicated in view *Y*. With this movement, ejector *C* shears off the sprue and discharges the surplus metal left in the chamber, which is now in the form of a solidified disk, as indicated at *E*. This slug ranges from 1/8 to 3/16 inch in thickness. In view *Y*, the movable die is shown withdrawn from the stationary die and the finished die-casting *F* is indicated on the face of the movable die.

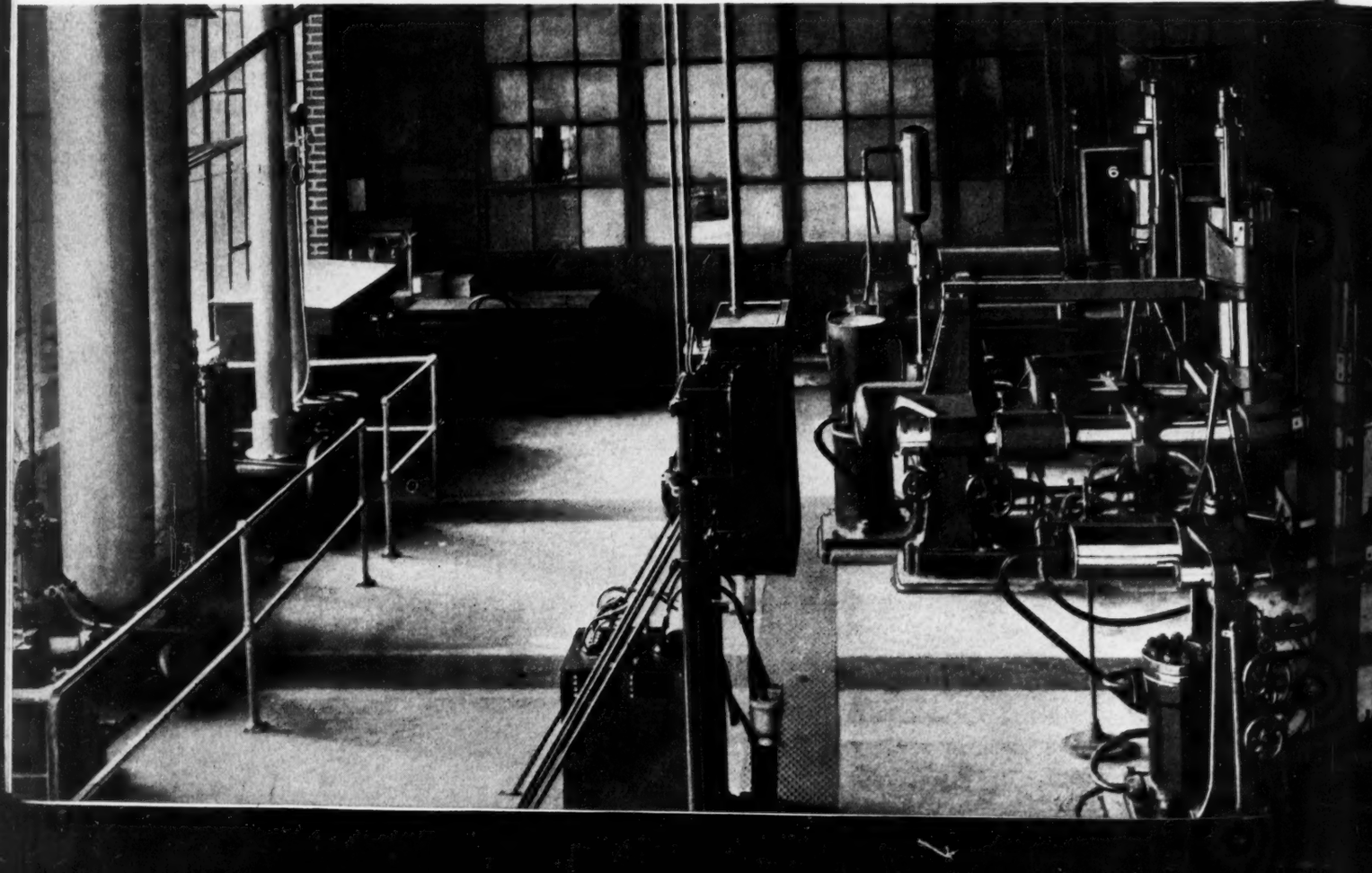
It is interesting to note that Polak machines are now also being built with the compression chamber in the dies themselves, as indicated in Fig. 4, rather than in the frame of the machine. In the left-hand view of Fig. 4, a charge of plastic metal *B* is being poured into the compression chamber to be forced by ram *A* into the die cavities through a vertical gate *D*. In the right-hand view of the illustration, the die-casting (indicated by solid lines) is being ejected from the stationary half of the die. In this method of casting, the surplus metal remains integral with the gate metal and must be trimmed off in a subsequent operation.

Construction of the Die-Casting Machines

The general construction of the various sizes of die-casting machines is the same. Large-diameter bars extend from the right-hand to the left-hand end of the machine to tie the large cylinder at the left-hand end (which actuates the movable die) to the upright casting at the right-hand end which contains the compression chamber and supports the overhead hydraulic equipment that operates the vertical ram. Ram *G*, Fig. 2, to which the movable die is attached, as shown at *H*, slides on the large horizontal bars.

In this illustration, the face of the stationary die may be seen at *J*, the gate leading from the compression chamber being seen at *D*. When the movable die opens, the casting falls down into a chute that leads to the front of the machine while the operator brushes the slug of surplus metal into a chute at the right-hand end of the machine that

Fig. 5. The Die-casting Department of the Titan ent Time Produce between 100,000 and 150,000 Are of the Polak Type which Produce the Die-cast



leads to a container at the back. On some machines, a lever automatically sweeps across the top of the compression chamber to throw the slug into its chute.

The raising of the ejector in the compression chamber at the end of each operation is effected by means of the lever that the operator is seen grasping with his left hand in the heading illustration. When the vertical ram reaches the end of its downward stroke, this lever is pulled toward the machine by a coil spring, so that it latches under a collar attached to rod *K*, Fig. 2. Rods *K* and *L* are attached to a slide that carries ejector *C*, Fig. 3. Thus, when the vertical ram rises, rods *K* and *L* and the ejector are lifted with it to eject the slug of surplus metal, as already mentioned. When this has been accomplished, the operator pulls the lever forward, as shown in the heading illustration, thus releasing rod *K* and permitting the ejector to fall into position for receiving the next charge of molten metal. The 3-inch ram has a clearance of 0.004 inch in the compression chamber.

Water is the medium employed to produce the hydraulic pressure for operating the die-casting machines. This pressure is developed by a triplex hydraulic pump, driven by a 30-horsepower motor. The pump has a capacity for delivering 30 gallons of water per minute at a pressure of 1750 pounds per square inch. The pump is used in combination with the air-loaded accumulator tanks seen along the left-hand wall in Fig. 5. The hydraulic pump runs constantly when the shop is in operation, but an air compressor need only be run two hours a month to maintain the required air pressure in the accumulator tanks. These tanks are 15 feet high.

Each of the die-casting machines is equipped with prefill cylinders adjacent to the horizontal ram cylinders, thus greatly reducing the amount of water under pressure that must be admitted into the cylinders for closing and locking the movable dies. On some of the machines, the piston of the prefill cylinder also intensifies the pressure on the water that is admitted. With this arrangement, from 3 to 4 gallons of water under high pressure are saved at each operation of a machine. Each operation of the largest die-casting machine consumes only from 1 1/2 to 2 gallons of water under the high pressure. This machine has a capacity for casting parts with an area up to 25 square inches or a weight up to 11 pounds.

The smallest machines in the department are equipped with a 1 3/4-inch ram which applies a pressure of 4980 pounds per square inch on the metal being cast. This size machine will cast parts with an area up to 7 square inches and a weight up to about 10 1/2 ounces. It consumes 1/2 gallon of water under high pressure at each operation. The medium-sized machines are fitted with 2 1/4-inch rams which exert a pressure of 5500 pounds per square inch on the metal being cast. Pieces up to 13 square inches in area and up to 21 ounces in weight can be produced in these machines.

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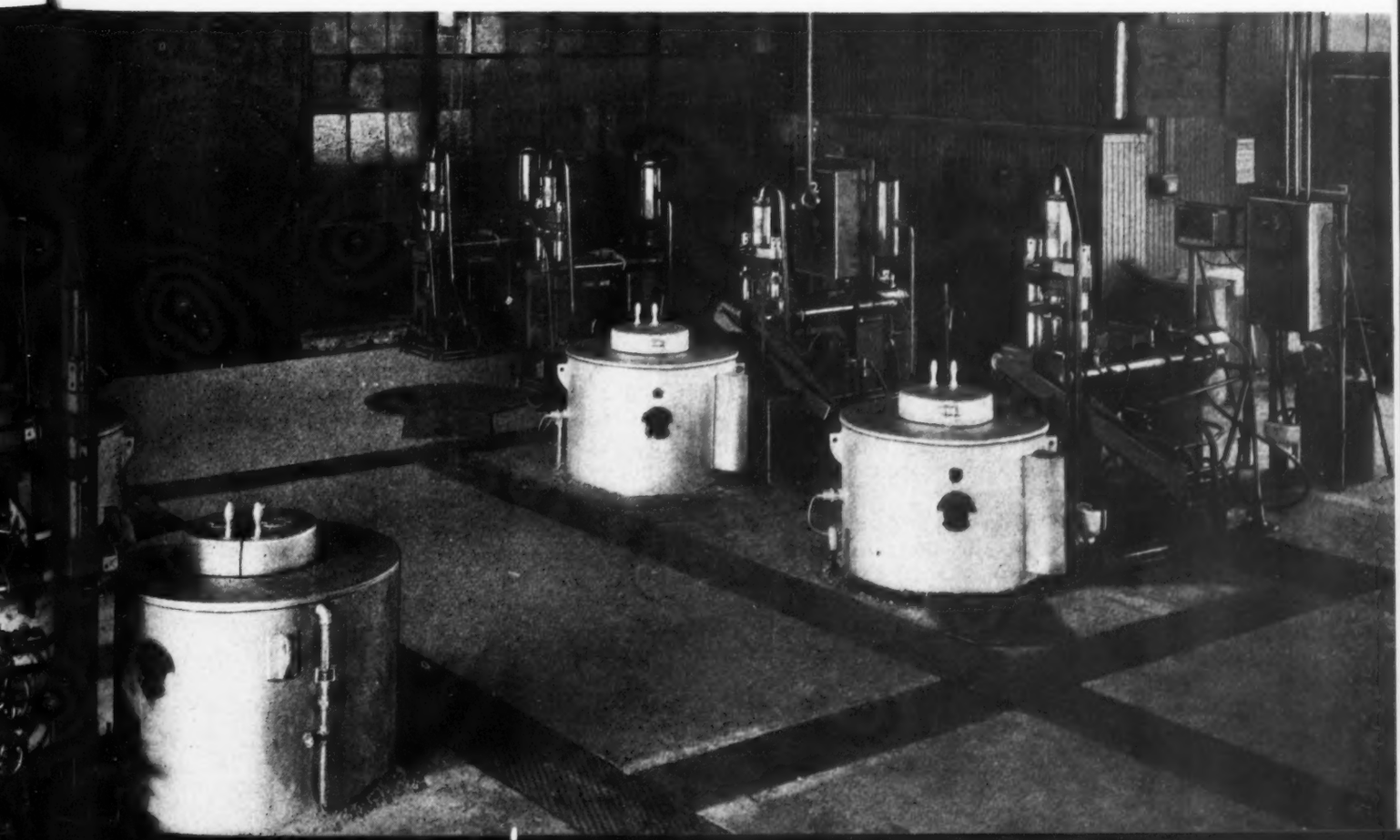
Metal Mfg. Co. Has Eight Machines which at the Present Time Are Producing Brass Die-castings Monthly. All of These Machines Are Operated by Hydraulic Pressure and Are Casting Parts from Brass in a Semi-molten or Plastic State



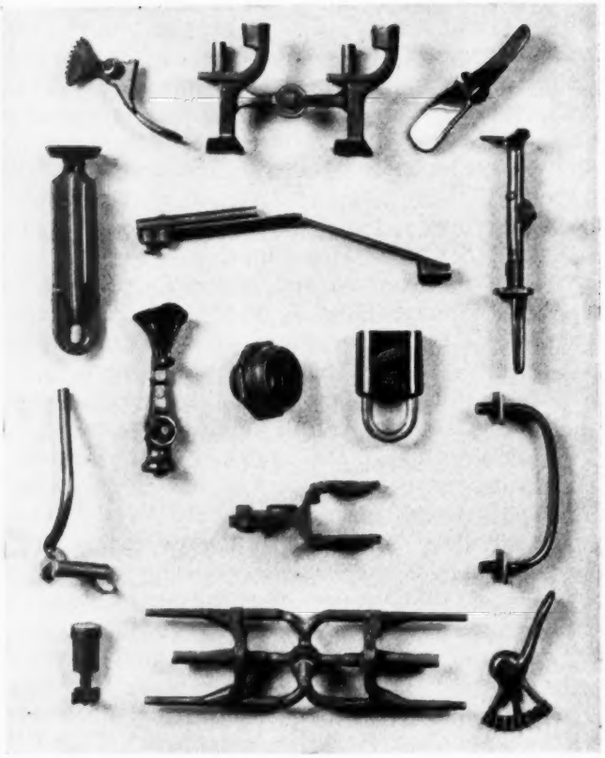


Fig. 6 Brass Die-casting Can Be Advantageously Employed for the Production of a Wide Variety of Parts. Some of the Examples Here Shown Have Cast Threads, and Others Cast Gear Teeth

The largest die-casting machine can be operated at the average rate of 100 "shots" an hour, while the other machines can be operated at from 1700 to 1800 "shots" per eight-hour day. On these machines, the operators must make 1000 shots per day before their bonus starts. Maintenance costs up to the present time on the die-casting machines themselves have been negligible, as no repair parts have been required even on the smaller machines which have been in use for four years. The repacking of valves is the principal expense.

What Kinds of Parts Can be Die-Cast from Brass?

Experimentally, practically any copper-base alloy can be die-cast, but in actual practice, certain problems arise, such as the rapid deterioration of the steel dies when the temperatures are too high. It has been found feasible, for instance, to cast alloys having a copper content as high as 93 per cent which have a melting point of about 1820 degrees F.

The analyses and properties of the copper-base alloys used extensively by the Titan Metal Mfg. Co. in brass die-casting were given in the July, 1934, article previously mentioned. These are a yellow brass and Tinicosil No. 20. The yellow brass contains from 57 to 59 per cent copper, 40 to 42 per cent zinc, 0.50 to 1.50 per cent tin, and 0.75 per cent lead. Tinicosil No. 20 contains 42 per cent copper, 41 per cent zinc, 1 per cent lead, and 16 per cent nickel. The yellow brass has a tensile strength of between 60,000 and 70,000 pounds per square inch, whereas Tinicosil No. 20 has a tensile strength between 85,000 and 95,000 pounds per square inch. Other properties are given in considerable detail in the previous article.

Alloys such as zinc, aluminum, and lead have also been cast successfully in the Polak die-casting machines from the plastic state. The variety of parts that can be cast from brass will be apparent from Fig. 6.

It has already been mentioned that brass die-castings have been produced with sections as thin as 0.030 inch, although this is really not practical commercially. The parts produced by the die seen in the machine in Fig. 2 are examples of quantity-production thin-section castings. These parts are disks 4 inches in diameter and only 0.063 inch thick.

The number of castings that can be made at one time depends upon their shape and size. In some cases, the casting must be produced singly, and in others as many as six can be produced at a time.

The dies for brass die-castings must be made of steels that will withstand to as great a degree as possible the high temperature of plastic brass. They must be heat-treated, and they must be dressed constantly while in use to remove the oxide which builds up in the die cavities. The dies must be preheated each time before using. These important factors in the application of brass die-casting dies will be outlined in an article to be published in a coming number of MACHINERY. That article will also describe the design of several typical dies.

Further advancement in brass die-casting depends upon the development of greater heat-resisting steels, as the industry is no longer handicapped by lack of knowledge on the part of the die-casters.

* * *

"Business, like the universe itself," says Robert Scudder Denham, chief engineer of the Denham Costfinding Co., Cleveland, Ohio, "is governed by fundamental principles or laws to which we can conform and succeed, or which we can violate and invite failure. The chief cause of industrial failures is the pernicious 'overhead distribution' fallacy, wherein the identities of definite expenditures are obscured by the creation of masses of unrelated expenses under the common titles of 'overhead' or 'burden.'"

Method for Determining Blank Diameters

By JOE W. JENSEN

EVERY diemaker knows the value of having a simple, easy method of finding the blank diameter for shells having a complicated outline, such as a fixture shell. The mathematical procedure followed in arriving at a simple formula for the blank diameter is given in the following. A method that facilitates finding the two dimensions required in the formula is also presented.

Almost all blank diameters are calculated on the assumption that the area of the blank and the area of the finished shell are equal. Thus,

$$\text{Area of blank} = \frac{\pi}{4}\ (\text{Diameter})^2$$

According to Pappus' rule, the area formed by rotating a line about an axis of rotation or center line is obtained by the formula,

$$\text{Area} = 2xL\pi$$

in which

x = distance from center of gravity of line to axis of rotation or center line; and

L = length of line.

The line L must not cross the axis of rotation. As the areas found by the two preceding formulas are designed to be equal, we have,

$$\frac{\pi}{4}\ (\text{Diameter})^2 = 2\pi xL, \text{ or}$$

$$\text{Diameter}^2 = \frac{4}{\pi}(2\pi xL) = 8xL$$

Thus, the diameter equals $\sqrt{8xL}$. This formula is easily remembered, and can also be written in the form:

$$\text{Diameter} = 2\sqrt{2}\ \sqrt{xL}, \text{ or } 2.8284\ \sqrt{xL}$$

The problem now is to find x and L. Many handbooks give the position of the center of gravity of many simple forms of lines. The length of the line to be rotated to form the surface that the finished shell will have is equal to the sum of the lengths of the small sections of line that form it, that is, straight lines, arcs of circles, etc. The total length of the line L will be equal to the sum of the sections L_1, L_2, L_3, etc., as shown in the upper view of the accompanying illustration. Now, if we let x_1, x_2, x_3, etc., be the respective distances from the center of gravity of each section of line to the axis of rotation, we have:

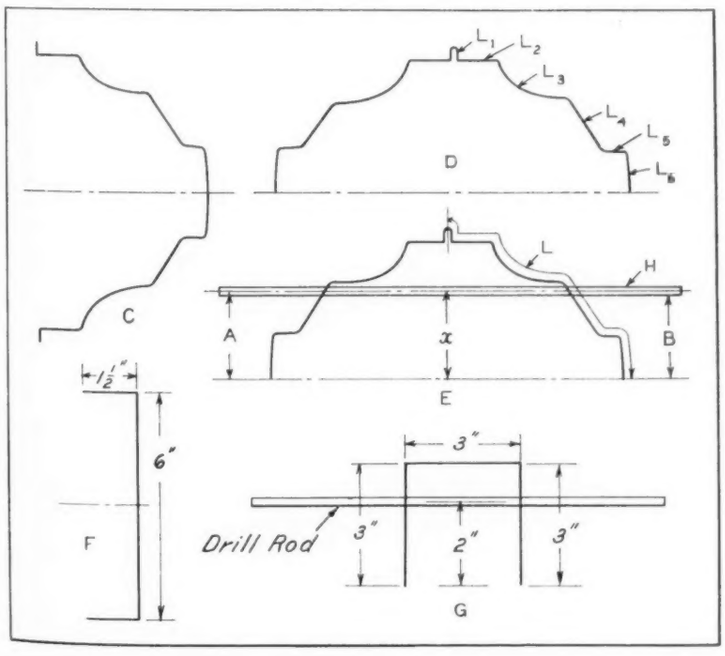
$$x = \frac{L_1x_1 + L_2x_2 + L_3x_3 \text{ etc.}}{L_1 + L_2 + L_3 \text{ etc.}}$$

Thus, x and L for a contour composed of simple lines can be found mathematically and used in the formula.

However, if the line is composed of parts that are not exactly straight lines or arcs of circles, or other simple forms, then this method cannot be applied. The mechanical method to be described in the following can be employed for complicated lines or contours. The mechanical method is so simple to apply that it seems preferable to use it for all lines or profiles, with the possible exception of the simplest outlines, such as the outlines for cylindrical shells.

Let us assume that we have a shell of the shape shown at C in the illustration. The profile line on one side of the center line or axis of rotation in the case of this shell would be composed of the parts L_1, L_2, L_3, etc. The section of part L_3 is not formed to a radius, and it would therefore be difficult to include this section in any numerical calculations.

First, an outline of the piece is laid out full size on paper, a reverse profile of the line being made as shown at D and E. A piece of bare copper wire of about 20 gage, of a known length and at least



Diagrams Used in Describing Method for Determining Blank Diameters for Irregular Shaped Shells

a little longer than the total length of the outline as shown at E, is bent to conform exactly to this outline. The extra wire is cut off and this length is subtracted from the known length of the wire, which gives twice the length of the line L. The wire should be formed carefully, so that it will lie nearly flat on a surface plate.

Next, a piece of small drill rod H, about 1/16 to 1/8 inch in diameter, is placed on a surface plate. The bent wire is then placed on the drill rod as shown at E, so that the wire is nearly balanced on the drill rod, with the distance A equal to the distance B. A small flat piece of steel is now placed on each end of the drill rod to hold it in position. Next, the drill rod, with the blocks on top, is rolled until the wire outline exactly balances. A scale is then placed under the wire and against the drill rod for measuring the distances A and B. The wire outline is now turned over, so that the opposite side is in contact with the drill rod, and the balancing and measuring operations are completed. All measurements should be the same, but if there are slight differences, the average distance is taken, to which is added one-half the diameter of the drill rod. This dimension equals x, which can be substituted for x in the formula

$$\text{Blank diameter} = \sqrt{8xL}$$

The finer the wire used, the more exact will be the results, although fine wire is more difficult to handle. However, it is surprising how little the blank diameter obtained is affected by small inaccuracies in the form of the wire and in taking the measurements A and B. It should be possible to measure A and B within 0.015 inch.

In case very accurate results are desired or the details of the shell are very small, the drawing of the line E can be made twice the actual size. In this case, the dimensions x and L will be double, and the result will be a diameter that should be divided by 2 to give the actual flat diameter required.

It is advisable for one to try this method first on a simple form of shell for which the blank diameter can be easily calculated by other methods. Take, for example, a shell as shown at F. This shell would have a wire formed as shown at G, and should balance in such a position that the distance A or B plus 1/2 the diameter of the drill rod will equal 2 inches. The length of one-half of the wire will be $\frac{9}{2}$, or 4.5 inches. Then, $x = 2$ inches and $L = 4.5$ inches.

Thus, we would have:

$$\text{Blank diameter} = \sqrt{8(2)4.5} = 8.4853 \text{ inches}$$

A New Rustproofing Method

ACCORDING to W. B. Hurley, of the Detroit Edison Co., writing in the *S. A. E. Journal*, there was recently developed in Detroit a new method of rustproofing, which, although still in the experimental stage, gives considerable promise of speeding up the operation of rustproofing and reducing costs.

In this process, a motor-generator set furnishes current at approximately 960 cycles. The parts to be rustproofed are cleaned in the ordinary manner, and after being rinsed, are passed through an induction coil, the heat generated by the coil quickly drying them off and preventing the formation of rust. While still hot, the parts pass into a rustproofing tank which contains activated phosphates. They immediately enter the field of another induction coil and are heated, thereby facilitating the deposition of a fine-grained coating of phosphate. On leaving the rustproofing tank, the parts pass through still another induction coil which quickly drys them. If required, they can then be painted and passed through an induction oven for final drying.

From tests so far made, this method of rustproofing appears to produce a more highly resistant rustproof film, and to produce this film more quickly and at less cost than similar methods not using induction heat. The cost of electricity is a small item wherever there are reasonable electric rates. In fact, with low electric rates, induction heat can be used also for keeping the rustproofing tank at the proper temperature. If the electric rates are too high in any locality, the tank can be heated with steam, and electric induction used only for heating and drying the parts to be rustproofed.

The fineness of the grain of the phosphate coating produced by induction heating apparently makes the phosphate film denser and more resistant to the penetration of moisture. The process is used at the plant of the Budd Wheel Co. in Detroit for rustproofing wheels preparatory to the painting operation.

* * *

A rising standard of living demands more goods and services of better quality and at lower cost. This is the service which the engineer is qualified to render. For this he was educated. This is his life work. In a society dedicated to this end, he will find profitable employment, satisfying recognition, and opportunity to work for the general good. With the scientist, the inventor, and the business executive of broad vision, he will pioneer in the finding of a new order as far surpassing our present one as the present surpasses the barbarism of earlier ages.—*Ralph E. Flanders, President, Jones & Lamson Machine Co.*

Steels Used for Die-Casting Dies

Based upon Information Supplied by Sam Tour, Vice-President, Lucius Pitkin, Inc., J.P.Gill, Metallurgist, Vanadium-Alloys Steel Co., and Other Die-Casting and Steel Specialists

THE selection of the proper steel or steels for a die-casting die depends upon the metal to be die-cast, intricacy of the casting, and probable life of the die. Of these factors the most important is the metal from which the casting is to be produced, because its melting point alone determines whether the die can be constructed from ordinary machine steel, or whether high-grade alloy steels must be employed and heat-treated after machining.

Ordinary Machine Steel Satisfactory for Metals of Low Melting Points

Dies designed for producing castings from zinc-, tin-, and lead-base metals can, as a general rule, be made from ordinary machine steel or cold-rolled steel, since the melting points of these base metals do not exceed 800 degrees F. If a zinc die-casting of complicated design, requiring a number of sliding cores, is to be produced or if the die must be made with sharp corners that will stand up for a long time, it is preferable to construct the die from nickel-chromium or chromium-vanadium steel. Some die-casting concerns make a practice of heat-treating alloy die steels, while others heat-treat only when certain die parts slide on others. Sometimes a 0.40 to 0.50 per cent carbon steel is heat-treated for this reason. Seldom is it necessary to heat-treat the parts of a die for casting tin and lead.

The steels identified by the letters *A* and *B* in Table 1 are widely used for die-casting zinc, tin, and lead. Steel *A* is ordinary machine steel, the lower carbon range being used for tin and lead and a carbon range of from 0.40 to 0.50 per cent being largely used for zinc. Steel *B* is a good grade of nickel-chromium, and *C* is a chromium-vanadium steel. Dies for producing parts from zinc, tin, and lead alloys ordinarily last for hundreds of thousands of castings.

Dies for Aluminum Castings Must Possess High Heat-Resisting Qualities

Aluminum-base alloys used in die-casting operations have a melting point up to about 1150 degrees F., and for this reason, dies for casting these base metals must be constructed of high-grade alloy steels and the steels must be heat-treated. Dies for casting aluminum are often made from a chromium-vanadium steel such as listed at *C* in Table 1, unless the castings are complicated or an exceptionally long life is required, in which case the die should be constructed from steels of the compositions listed at *D* and *E*. The same steels are also suitable for the die-casting of magnesium-base alloys.

The particular requirements of a steel for die-casting aluminum-, magnesium- and copper-base alloys have been listed as follows:

(1) Machineability; (2) stability in heat-treatment; (3) resistance to heat checking; (4) resistance to deformation, battering, etc. (hardness); (5) resistance to cleavage cracking on sudden heating or cooling (toughness); (6) resistance to the erosive and solvent actions of molten metal; (7) cleanliness and uniformity; (8) cost — productibility, forgeability, etc.; (9) ability to withstand elevated temperatures.

From the standpoint of machineability, chromium-vanadium steel seems to be quite satisfactory; hot-working tungsten steels are somewhat more difficult to machine. Austenitic steels, in general, are out of the question.

From the standpoint of stability in heat-treatment, the chromium-vanadium steel (steel *C* in Table 1) that has been in general use for many

Table 1. Compositions of Steels Commonly Used for Die-Casting Dies

Chemical Element	Letters Designating Different Types of Steel							
	A	B	C	D	E	F	G	H
Carbon	0.20–0.50	0.40–0.50	0.40–0.50	0.30–0.40	0.30–0.40	1.40–1.50	0.35–0.45	0.25–0.35
Manganese	.....	0.65–0.80	0.40–0.80	0.20–0.35	0.20–0.35	.....	0.20–0.35	0.20–0.35
Silicon	.....	0.30	0.30	0.8–1.0	0.8–1.0	.....	0.35	0.35
Chromium	.....	0.75–0.90	2–2.50	4.75–5.75	4.5–5	12–13	2.5–3.5	2.5–3.25
Vanadium	.....	.....	0.15–0.30	.....	.....	.....	0.30–0.60	0.30–0.60
Nickel	.....	1–1.50	.....	.....	.....	.....	.....	.....
Tungsten	.....	.....	.....	4–5	0.75–1.25	.....	8–10	12–16
Molybdenum	.....	.....	.....	.....	1–1.50	0.50–0.60	.....	.....
Cobalt	.....	.....	.....	0.50	.....	3–4	.....	.....

Table 2. Brinell Hardness of Die Steels Listed in Table 1

Base Alloys for which the Listed Die Steels are Used	Letters Designating Different Types of Steel							
	A	B	C	D	E	F	G	H
Tin	220	170–220	.....	.....	.....	.....	.....	.....
Lead	220	170–220	.....	.....	.....	.....	.....	.....
Zinc	170–250	170–300	300–402	.....	360–402	.....	.....	.....
Magnesium	.....	.....	387–430	402–444	402–444	.....	.....	.....
Aluminum	.....	.....	402–444	420–460	420–460	430–517	444–517	444–517
Copper	.....	.....	.....	.....	.....	430–517	444–517	444–517

years for making dies is not wholly satisfactory, because of its tendency to warp, grow, shrink, and crack during the heat-treating process. The tungsten-chromium and molybdenum-chromium types of air-hardening die steels listed in the tables are satisfactory from the standpoint of stability in heat-treatment.

Dies Sometimes Fail from Heat Checking and Cleavage Cracking

With practically all steels, the die life seems to be determined, as far as heat checking is concerned, by the initial hardness. Up to the point where insufficient toughness remains in the steel, it appears to be true that the harder the block, the longer it will stand up.

Apart from the relation between hardness and resistance to heat checking, a certain amount of hardness is required for service reasons. Dies are made up of moving parts—slides, cores, pins, etc. —and are usually hot when in operation. Therefore, all die parts must be hard enough to prevent excessive rubbing, scoring, and seizing of the parts. All parts should be hard enough to resist defacement or deformation resulting from the powerful closing action of die-casting machines, should stray pieces of metal become accidentally caught on the parting faces of the dies.

Cleavage cracking is not a serious difficulty with the chromium-vanadium steels, but it is serious with the chromium-tungsten steels. Cleavage cracking does not seem to have much relation to the hardness, but is more closely associated with the macrostructure.

Erosion and a solvent or soldering action of the molten metal are likely to occur at the gates of dies where the molten metal is at maximum temperature and is made to travel at high velocities across the die steel. The erosive action sometimes becomes severe when the molten metal impinges directly on a die surface. Resistance of the steel to a solvent action and to erosion are therefore important requirements.

Cleanliness and Uniformity are Essential in Die Steels

Cleanliness and uniformity are essential in a die steel because segregations and non-metallic inclusions serve as starting points for thermal fatigue failures and cleavage cracking. Segregations appearing as hard spots will also cause difficulties in die-sinking. There must be no internal seams, slits, cracks, or other defects at or near the base of a die impression after the greater part of the die-sinking has been done.

Die-casting dies are subject to temperatures ranging from room temperature or lower (as when water is used for cooling the dies) up to 2300 degrees F. (in casting aluminum bronze). Small uncooled parts of dies near the gate, which are almost completely surrounded by molten metal, often become heated almost to the temperature of the incoming metal. In many cases, the surface of the die steel becomes red hot before the body of the die can conduct the heat away. For this reason, red hardness seems to be a desirable property for a die-casting die steel that is to be used in casting alloys of a high melting point.

Brass Die-Castings Require Dies Made from Semi High Speed Steel

The high temperatures required in die-casting copper-base or brass alloys make it necessary to use a different grade of steel than is required for aluminum die-castings, and of course the steel must be heat-treated. Steels that have proved satisfactory for copper-base alloys are listed at *F*, *G*, and *H* in Table 1. In addition to these steels, one producer of brass die-castings makes dies from a steel of the following analysis: Carbon, 0.30 to 0.40 per cent; chromium, 1.75 per cent; vanadium, 0.50 per cent; and tungsten, 10 to 12 per cent.

The maximum die life in casting copper-base alloys ranges from 20,000 to 50,000 pieces. However, considerable dressing is necessary from time to time to insure a smooth finish on the castings, because even the best steel that is available will check.

The Hardness of Die Steels after Heat-Treatment

Die-casting die steels are usually machined in a soft annealed condition and heat-treated after finish-machining. The temperature and length of time required for the various steps in the heat-treatment depend on the type of steel and the size and intricacy of the piece being treated. The standard procedure in heat-treating chromium-vanadium and tungsten-chromium die steels starts with normalizing, after forging, at a temperature between 1700 and 1800 degrees F. After being

normalized, these steels are annealed, the temperature range for the two types of steel being 1425 and 1600 degrees F. Tungsten steel for casting copper-base alloys is annealed immediately after forging instead of being first normalized. This steel is annealed at a temperature of between 1600 and 1650 degrees F. The cooling is retarded at around 1450 degrees F. to obtain the desired structure. The normalizing and annealing operations are generally performed at the steel mill; hence the user is not particularly concerned with the details of the two treatments.

The high temperatures involved in heat-treating die steels make it necessary to protect the surfaces during the heat-treatment. This is customarily done by packing the dies in cast-iron chips or aluminum-oxide pellets or heating them in controlled-atmosphere furnaces.

In the hardening operation, die steels are heated to temperatures ranging from 1600 to 1900 degrees F., depending upon the particular type of steel. They are then quenched in oil or cooled in still air. Steels for copper-base alloys are preheated to a temperature of from 1500 to 1550 degrees F. before hardening. After hardening, die steels are tempered by practices that have been developed especially for each type of steel. The exact temperature to be used and the procedure to be followed in heat-treating die steels are generally supplied by the manufacturers.

Table 2 gives the Brinell hardness numbers of the various steels listed in Table 1 and shows which steels are used for the different die-casting metals. All hardnesses above 220 Brinell are, of course, obtained by proper heat-treatment.

Die-casting dies are often given a protective coating before being placed in service. Commercial coatings are available for this purpose.

Industry's Big Problem—Trade Training

IN his presidential address before the annual meeting of the National Machine Tool Builders' Association, Charles J. Stilwell, vice-president of the Warner & Swasey Co., referred to the necessity for giving increasing attention to the training of apprentices, as well as machine operators. Said Mr. Stilwell: "There is a serious shortage of skilled workmen. The shortage comes about from causes that are too familiar to require explanation. What we are more anxious about is the cure.

"I presume we would all agree that of fundamental and primary importance is the quick resumption of our apprentice training courses and other systems of training, wherever such a resumption has not already taken place. Ordinary machine operators, semi-skilled and skilled assemblers, fitters, etc., are the increasing necessity of the moment; but, after all, the great need that we will find in our various organizations during the next few years will be for the all-around well trained machinist. It is not to such a group we must look only for the workmen to perform our finer operations where skill and judgment are required, but also for the growing number of inspectors, foremen, and shop executives that will be needed in rebuilding our production organizations in the period of reconstruction. This need is developing far more rapidly than it can be satisfied.

"When we take into consideration the fact that with but very few exceptions apprentice courses were practically abandoned in 1932 and 1933, it is altogether probable that in setting up apprentice courses, provision must be made for an additional number of apprentices in training over and above the normal average enrollment in years gone by. By no other means can the accumulated shortage of all-around skilled mechanics, such as we need in our industry, be supplied.

"The second problem of the production man is the overwhelming shortage — a seemingly disproportionate one—in the supply of reasonably experienced machine operators. No time can be wasted in setting up training courses of varying and appropriate lengths of time to train, at our own expense, substantial, reliable workmen that are needed and will be increasingly needed from this moment on.

"It is a safe prediction that within a very few months every plant in this industry will be confronted with the problem of turning away business that is available, for no reason other than the shortage of trained men."

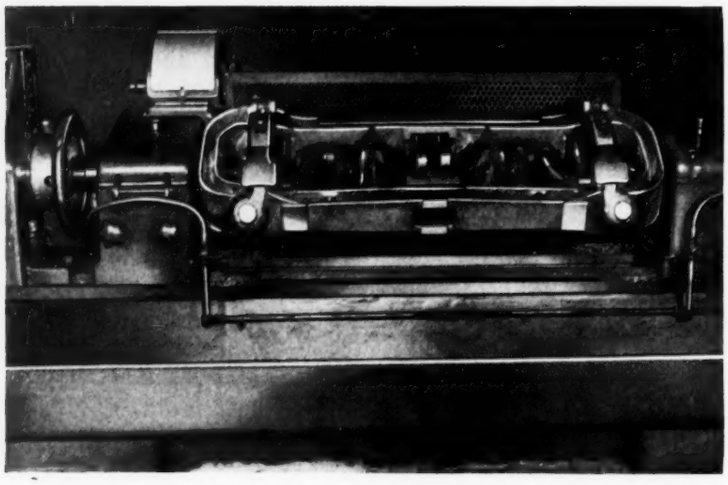
* * *

Foundrymen Sponsor Apprentice Competition

The American Foundrymen's Association is sponsoring a contest for apprentices in iron molding, steel molding, and patternmaking, in connection with the 1936 convention, to be held in Detroit during the week beginning May 4. The plans call for preliminary contests to be held by individual foundries or local trade associations. The winning castings and patterns from these local competitions will be forwarded to Detroit, where a committee of judges will select first, second, and third place winners, who will be awarded prizes by the association.

Copies of the regulations for the local contests can be secured from the Apprentice Committee, American Foundrymen's Association, 222 W. Adams St., Chicago, Ill. In the last contest, held in 1931, thirty-nine plants in the United States and Canada entered the work of some two hundred apprentices.

New Methods Introduced in



Mass Centering Machine for Centering Crankshaft Forgings before Machining. This Machine Roughly Balances the Crankshaft so that the Centers are Drilled at the Approximate "Center Line of Gravity" of the Forging

A Procedure Called "Mass Centering" Facilitates the Final Balancing of Crankshafts

ONE of the outstanding features of the methods used in machining Buick crankshafts is the means adopted for reducing to a minimum the amount of balancing required in the finished shaft. In an investigation made at the Buick plant, it was found that some 60 to 70 per cent of the final work required to obtain balance in crankshafts was due to the methods of centering used, through which the mass of metal in the crankshaft became inaccurately distributed.

With the methods adopted in the forge shop, where new forging and heat-treating equipment has been installed, the forgings are held to much closer limits than is usually the case. The fact that almost no straightening of the crankshafts is required is one indication of the workmanship in the forgings. Another is the balance that obtains in the forgings themselves before being machined.

It is evident, however, that no matter how accurate the forgings are nor how well the mass of metal is distributed to secure balance, this balance can be offset more or less according to how the stock is removed from the forging during the machining process. In other words, fairly well balanced forgings can be machined into unbalance.

It is this condition that is avoided by the methods used in the Buick plant, where an ingenious centering machine is used at the beginning of the production line for centering the crankshafts to obtain proper distribution of the mass of metal. The machine is, therefore, known as a "mass centering" machine. In this case, "mass" has no relation to mass production, but simply to the mass of metal in the crankshaft.

The centering machine consists essentially of an electric balancer and center drilling equipment. As the shafts come from the forge shop they are located in a cradle mounted horizontally in the electric balancer and held at each end by four plungers 90 degrees apart. One of each pair of opposed plungers is floating under spring pressure while the opposite plunger is minutely adjustable by means of a small electric motor built right into the cradle, with a high-ratio gear reduction to the plunger shaft. There are two of these electric motors at each end of the cradle.

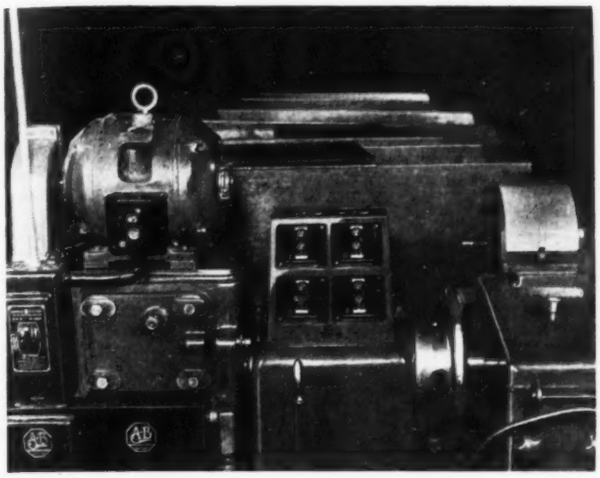
Principles of Operation of Mass Centering Machine

By means of the plungers, the shaft position can be adjusted to any location within the cradle. On the control board of the machine are located eight push-buttons, two for each motor, one of which is for the advance and one for the return of the plunger. At the rear of the control board there is a continuous light-beam indicator similar to that used on the regular General Motors crankshaft balancers. This indicator shows where the "out of balance" is located and the amount, when the cradle containing the shaft is rotated in the machine. The glass indicator plate on which the light beams register (there being a separate beam for each end of the shaft) is divided into eight zones corresponding to the four quadrants and locating plungers on each end of the shaft.

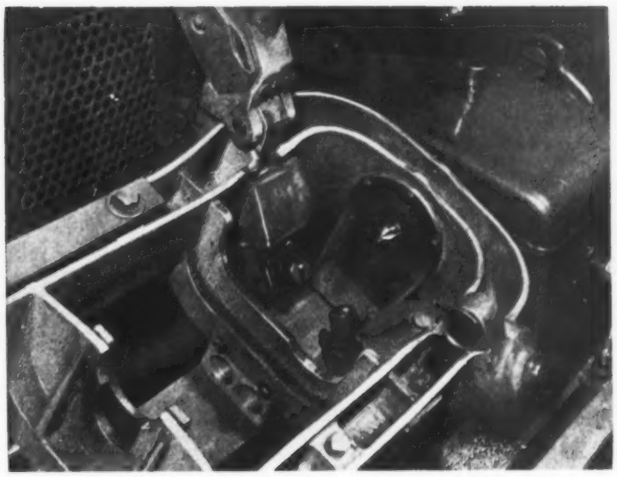
By advancing or reversing the electric motors in the crankshaft cradle, both ends of the shaft are brought to "mass center"—indicated on the view plate by the light-beam curves being located between two vertical lines spaced apart an amount equal to the tolerances permitted.

When this condition is reached, the machine is stopped, the cradle locked against turning, and the

Machining Buick Crankshafts



A Close-up View of the Buick Mass Centering Machine for Crankshafts, Showing the Light-beam Indicator at the Right and the Control Board for Operating the Plunger Motors at the Center



View Showing Cradle in which Crankshaft is Held and Plungers on which it Rests while being Centered. The Housing for One of the Electric Plunger-adjusting Motors will Also be Noted

centering drill feed started. The two centering drills then automatically drill and countersink correctly located centers in the shaft to the specified working depth. During the operation, the drills automatically recede once to clear themselves of chips.

By centering the shafts in this manner, from 60 to 70 per cent of the corrective machining formerly required for final balance was eliminated. The centers are used for locating throughout the machining sequence. Provision for locating for crank indexing is made immediately after centering, and consists of milling locating spots on the No. 1 and the No. 8 crankpin throw cheeks.

Turning and Forming the Main Bearings

Now follows the rough-turning and forming of the main bearings, except the center bearing, which is used as a steadyrest and is later machined separately. The shorter throws are also cheeked in this operation. The long cheeks at the counterweights are machined in a subsequent operation while finish-turning the main bearings.

In turning and forming the main bearings, three tools are used for each bearing. On one side are located two tools for cheeking and forming the radii at the journal ends, together with a portion of the journal, while on the opposite side is a single broad-faced tool for turning the major portion of the journal—the cut, of course, overlapping that of the other tools.

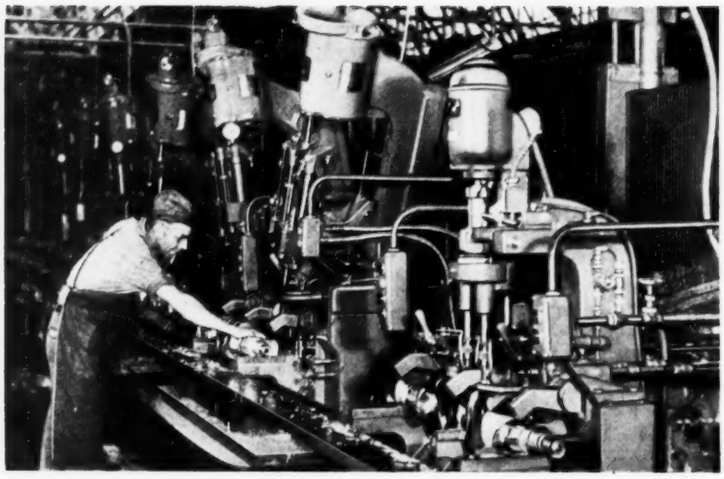
These crankshaft lathes are equipped with variable-speed motors which automatically increase the rotative speed of the crankshaft as the tools feed in toward the center, so that, particularly during cheeking, the same cutting speed in feet per minute obtains throughout the operation.

The Drilling of the Oil-Holes

For drilling the oil-holes, a line of multiple-spindle, individual-head, automatic drills of novel design are installed. The feed of these drills may be designated the "resistance step" type. Within each head, between the individual motor and the drill spindle, is a spring-loaded friction clutch with the spring tension manually adjustable, so that the clutch can be set to disengage at any required resistance. This resistance is set so as to prevent the breakage of drills.

As the drills feed into the shaft, the resistance builds up, in part due to the accumulation of chips. At a given moment, the friction clutch disengages and the drill retracts quickly. This retraction closes an electrical circuit. The clutch then re-engages and a high-speed feed quickly returns the drill to a point a few thousandths of an inch above the position from which it was released. At this point, another electrical circuit is cut in, re-establishing the normal cutting feed. A combination of electrical and hydraulic control is utilized.

With this set-up, production rates in drilling have been materially increased and drill breakage has been practically eliminated. Furthermore, the number of times that the drill retracts while drilling an oil-hole is a reliable guide as to the sharpness of the drill, and also serves as a gage of the



Drilling All the Holes in the Crankshaft Progressively. The Drills in These Machines Automatically Recede and Clear Themselves of Chips when the Resistance to Drilling Builds up to a Predetermined Point

uniformity of the metal in the shaft. Hard spots obviously would cause more frequent retractions.

All oil-holes are inspected for internal burrs or chips by mounting the shaft on an inspection table provided with indirect lighting which is so arranged as to illuminate the interiors of the drill passages from below.

Grinding Operations on the Crankshafts

The grinding of the shafts is done entirely with hydraulic-feed grinders. The tolerances are held to within 0.0005 inch. Mechanical wheel-dressers are used for the grinding wheels, as they have been found best for maintaining an accurate form for the wheels, as well as a smooth surface on the ground work.

For the grinding of the center crankpins, special chucking heads are provided, straddling the end throws, so as to use the end intermediate main bearings as additional steadyrests.

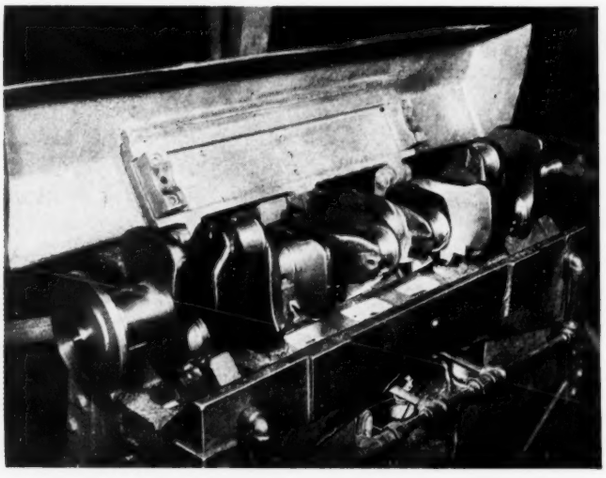
A five-station, multiple-tooling, indexing machine is used for performing all machining operations on both ends of the crankshaft. This includes rough- and finish-turning of the forward stepped end of the shaft, turning and forming the flywheel flange, and drilling and reaming the flywheel bolt holes.

Balancing and Final Polishing Operations

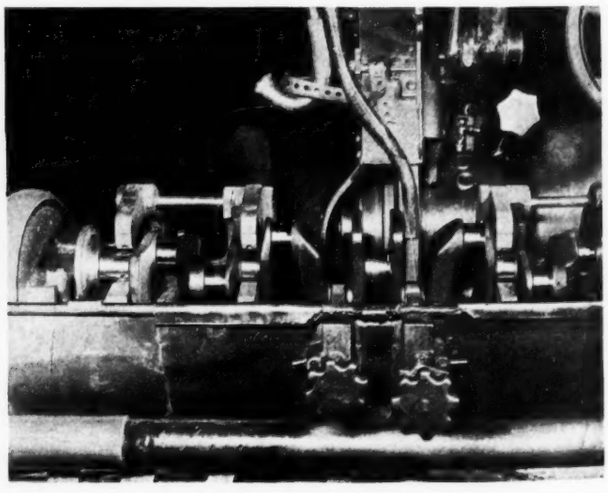
Now, with the shaft finished, except for lapping and polishing, it goes to the rough-balancing line. It is first rough-balanced on a General Motors vertical balancer, and the amount of correction and location marked on the shaft. After the corrective drilling following the rough balancing, the shafts move to the final balancer, used largely as a check on the accuracy of the balancing. If necessary, of course, the shafts can be sent back for further correction.

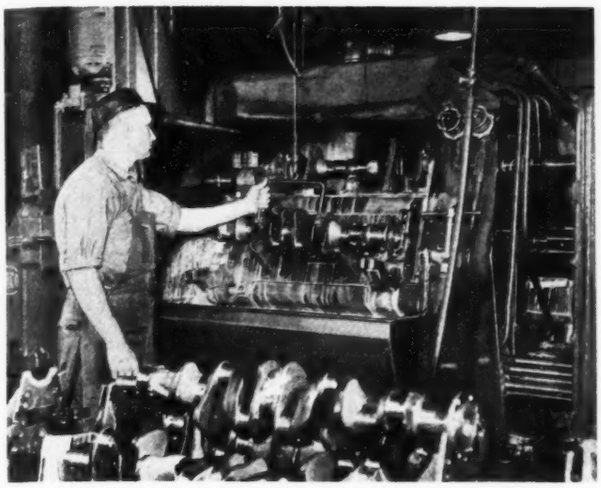
To obtain as fine a finish on the bearing surfaces

With this Equipment the Oil-holes in the Crankshaft are Inspected for Chips and Burrs. Note the Holes in the Base of the Fixture through which Light is Reflected into the Drilled Holes

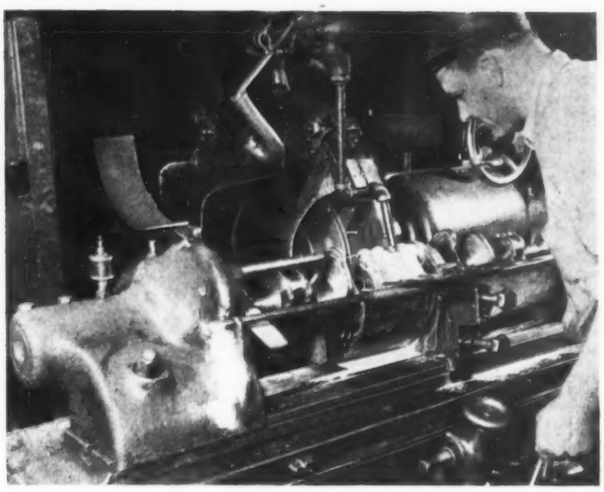


In Grinding the Pin Journals at the Center of the Crankshafts, Special Heads are Provided for Straddling the End Main Bearings, so as to Use the End Intermediate Main Bearings as Extra Steadyrests





Crankshaft Ends, Flywheel Flanges, Holes, Stepped Front Ends, and Other Parts are Machined on This Five-station Rotary Indexing Machine



A Rubber-bonded Polishing Wheel is Used in the Last Operation on the Crankshaft for Polishing the Thrust Face at the Center Main Bearing

as possible, the crankshafts are rough- and finish-lapped, using different grades of lapping cloth. Then the shafts are inspected for size, taper, length of throw, concentricity of journals, pilot holes, keyways, etc.

The last operation on the shaft is the final polishing of the thrust face at the center main bearing. This operation is reserved to the end in order to safeguard the finish against damage in handling. A rubber-bonded polishing wheel is used for this purpose.

While much of the equipment and tooling of these crankshaft lines is highly specialized, the basic elements of the machines used—with the exception, perhaps, of the balancers—are standard in character, so that the equipment is highly flexible, calling for a minimum of change in case of changes in the design of the crankshafts.

It is Time to Recognize that Industry Has Done a Good Job

IN the vast volume of literature that has been published relating to business depressions, the faults of our economic system, and the cure-alls, a small book "What Must We Do to Save Our Economic System?" by Thomas Nixon Carver, stands out as one of the most thoughtful and fundamental inquiries into our present difficulties.

Dr. Carver deplores the lack of ideas and constructive thought in high places. He points to the bewilderment caused by the effects of the vast productive power which private enterprise, aided by engineering, has built up. If we cannot think of anything better to do with this vast power, which, if properly directed, could make poverty and want a thing of the past, than to force it to slow down or lie idle, we obviously are sadly in need of constructive ideas. But still worse is the reasoning that proceeds somewhat as follows: "Our industrialists and engineers have done their work so well as to have run ahead of everything else. They have produced everything which private industry can produce in the greatest abundance; therefore, we must take industry out of the hands of those who made it so very efficient, and put it into the hands of politicians."

A more constructive line of reasoning, says Dr. Carver, would be somewhat as follows: "Our industrialists have done their work remarkably well. There are other great needs, however, that our industrialists cannot supply. Therefore, we would do well to leave industry under the management of those who have guided it so well and have our governments—national, state, and local—undertake to supply, on a large scale, those needs that industry cannot supply. This work may be grouped under four heads: Education, beautification, sanitation, and conservation."

This is constructive economic thought; but obviously such work must not be planned as mere relief work, to be carried out haphazardly and inefficiently. It must be carried on as a program of planned constructive work, financed not out of the future, but through a sane system of taxation that will make a balanced budget possible.

Engineering News Flashes

The World Over

Heavy Oil Engines for Airplanes

From Europe comes news that the Dornier Co. has constructed a new flying boat propelled by two 560-horsepower heavy oil engines. The plane is designed for a cruising speed of about 125 miles an hour, with a range of approximately 2500 miles.

World's Largest Transformers

Surge tests of 1,600,000 volts and insulation tests of 576,000 volts at 120 cycles are being applied to the world's largest electrical transformers built for the city of Los Angeles by the Westinghouse Electric & Mfg. Co. Seven of these transformers will step down the 287,500-volt Boulder Dam transmission line to the Los Angeles 132,000-volt distribution system. These transformers cost nearly $1,000,000 each; they are rated at 65,000 K.V.A. continuously, and 80,000 K.V.A. for two-hour emergency loads. They are 35 feet high and measure at the base 12 by 23 feet. Their weight is 116 tons each, the coils alone weighing 53 tons.

All-Welded Steamship Proves Successful in Service

According to *Engineering*, the all-welded British oil-tank steamer *Moira*, completed by Swan, Hunter & Wigham Richardson, Ltd., Wallsend-on-Tyne, in May, 1935, has returned to Wallsend to be dry-docked after a voyage across the Atlantic and to the west coast of Africa, during which heavy weather was encountered. An examination of the vessel did not disclose the slightest sign of strain or leakage anywhere in the hull of the ship. The *Moira* is 245 feet long, with a dead-weight carrying capacity of about 2500 tons.

Unusual Application of Lift Truck

A snow plow arranged so that it can be applied to the front of any power lift truck in from five to ten minutes is being built by the Easton Car & Construction Co., Easton, Pa. This lift-truck attached snow plow is intended for use in plant yards and runways to keep the trucking passages clear. The attachment is so arranged that the snow can be plowed to either side of the runway. The blade can even be set at right angles to the truck for clearing out drifts. By operating the lift platform of the truck, the plow can be raised or lowered into the working position. The snow-removing blade is 20 inches in height and 4 feet 6 inches in width.

Sheffield Steel Industry Breaks Former Records

The British steel industry in the Sheffield area is developing with remarkable rapidity. Late in 1935, the output was at the rate of nearly 1,400,000 tons a year, compared with approximately 1,000,000 tons two years ago, and less than 800,000 tons five years ago. Many of the plants worked continuously through the Christmas holidays. The bulk of the demand is from the British home market. It is to be noted that the production for armaments is said to be comparatively small; the industrial demands for peaceful activities form the bulk of the output. The manner in which British industry has recovered, the attitude of the British government toward industry and commerce, and the policies of British labor leaders, all point a lesson that might well be studied in the United States.

New Slushing Compound Resists High Humidity

After hundreds of tests carried out over many months in a specially constructed tropical room, the Detroit laboratories of the Ethyl Gasoline Corporation have developed a slushing compound which prevents corrosion in a humidity of 90 per cent and at temperatures up to 100 degrees F. The compound, having the appearance of a brown oil which may be sprayed on the objects to be protected, forms a jelly-like film and is said to afford protection to mechanisms and machinery of the most delicate construction. The new compound is composed of triethanolamine, 5 to 6 per cent; aluminum stearate, 10 per cent; butanol, 10 to 12 per cent, and lard oil. It is believed that it will find a wide application in the machinery industries.

Two More Huge Generators for Boulder Dam

Work will be started in March in the Schenectady plant of the General Electric Co. on two more 82,500-K.V.A. generators for Boulder Dam. One such generator built by the General Electric Co. is now being installed at Boulder Dam, and another is in process of shipment. The Boulder Dam generators are larger than any previously built. Each generator will weigh more than 2,000,000 pounds; will have an over-all diameter of 40 feet; and will rise 32 feet above the floor level. Forty freight cars will be required for transportation.

Recording Weights at Long Distances from the Scale

Remote registration of weight was demonstrated by the Toledo Scale Co. at the Chemical Exposition in New York early in December. This was the first demonstration of an entirely new method for weighing objects in one location and registering the weight, as transmitted over wires, in another place. Applications of this new development are expected to be numerous in operations where the actual work of weighing is carried on at a location remote from the offices where the weights are most conveniently recorded. The chemical industries, in general, and mining are fields that readily suggest themselves.

The Competition in Railway Train Speed

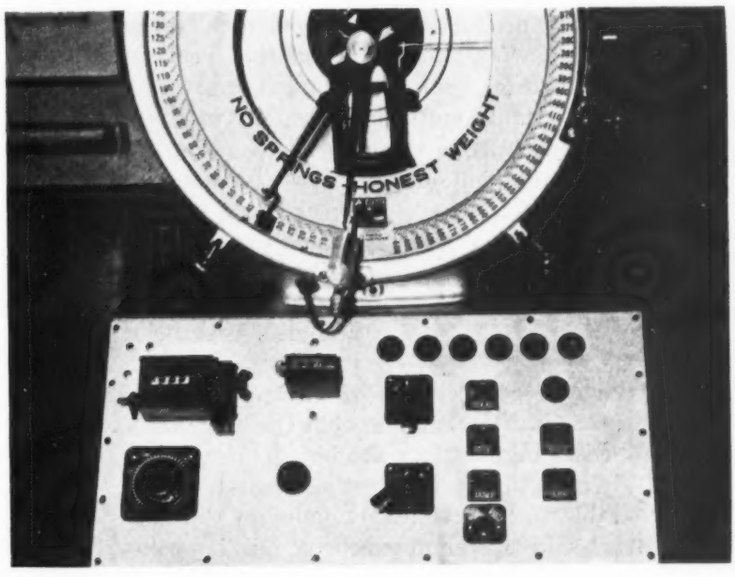
Coal is plentiful in Great Britain, while oil is expensive. British railroad engineers, therefore, have concentrated on obtaining the same results in speed and smoothness with steam locomotives as have been achieved here with light-weight Diesel-electric units. Previous to the inauguration of a new train service between London and Newcastle, where a four-hour run is made at an average speed of 67 miles an hour, including one stop, a test run was made with a train consisting of seven cars. During this test run, the highest speed attained was 112 miles per hour. Twenty-nve consecutive miles were covered at a speed of over 100 miles per hour, and an average speed of more than 100 miles per hour was maintained for forty-three consecutive miles, with an average of 107.5 miles per hour for twenty-five consecutive miles. It is claimed that these performances for continuous running at average speeds over 100 miles per hour constitute record runs. Apparently the steam locomotive is still holding its own as regards speed.

Concealed Hinges for Automobiles

Concealed hinges for automobile doors are one of the refinements recently developed by a Detroit manufacturer. Besides eliminating the unsightly projections from the sides of the body, this new type of hinge facilitates painting, striping, and polishing, especially when the latter operation is performed mechanically. The hinges are interchangeable, making it unnecessary to have rights and lefts. As this type of hinge requires only a shallow recess, its installation results in a stronger door post or pillar.

New Lamp Reproduces Daylight

The difficulty of controlling color values because of the variation of daylight at different times of the day is said to be overcome by a new lamp developed by the Claude-General Neon Lights, Ltd., London, England. This lamp maintains an almost constant standard of light, and enables colors to be matched to a degree of accuracy unobtainable even in natural daylight.



The Toledo Remote Control Scale by which it is Possible to Control from a Central Office the Weighing Operations in Another Part of the Plant

EDITORIAL COMMENT

According to figures published by the Ford Motor Co., this company spends approximately $9000 for buildings, machinery, and other expenses for each man employed. This is the part that capital plays in the industrial scheme. When a man is hired to go to work in industry, the employer must provide him with a place to work—a factory building—and machines and tools to work with. The latter are expensive. He must also have materials on which to use the tools, and materials are costly.

How Much Does it Cost to Employ a Man in Industry?

The Ford company finds that for each employe at work it must spend about $2000 for real estate and buildings, $2700 for machinery, and close to $700 for materials and supplies.

Then there are a few other things to be paid. For one thing, taxes must be paid or there would be no factory at all. Then, to keep the necessary stock from day to day, to pay wages promptly before the goods produced have been sold, to generate the power used to drive the machines, and to maintain the shop from the time the goods have been produced until the money comes in from their sale requires a sum of ready cash. Besides, the machines are wearing out and must be replaced. All together, these costs run into another $3600. Thus, someone has to supply about $9000 of capital in order that someone else can be put to work.

Recently the production manager of a large plant called our attention to the fact that prevailing cost estimating methods frequently are the cause of unprofitable methods being perpetuated. He referred especially to the case where parts are being made on the "outside" at a cost presumably lower than that at which they can be made in the home plant. By strict cost accounting methods, for example, including interest and depreciation of machinery, rent, insurance, etc., it often happens that the home shop will show costs higher than the bid of an outside concern. According to the cost accountant, it is then profitable to have the work done on the outside. "But," said this shop executive, "is it profitable if meanwhile your own machinery stands idle? You pay interest and depreciation just the same; you pay rent and insurance just the same. Judgment and common sense must be applied to cost estimating as well as to everything else."

Good Judgment Must be Applied to Cost Estimating

Of late, the importance of apprentice training has been repeatedly referred to in MACHINERY. The subject is one of such prime importance to American industry today that it can hardly be overemphasized. In some industrial centers, systematic cooperative efforts in apprentice training have been made by the industries, but in most localities, the problem is one that has received little attention, except by perhaps one or two manufacturers. Some of the large industries are beginning to do their share in the training of men. For example, some of the automobile plants have excellent training methods, although others have practically none. Doubtless here is an opportunity for industry to cooperate, with the view of developing a general training program.

American Industries Must Face Problem of Trade Training

Much of the unemployment today is due to lack of training. If we except the building industry, men with trade training are now able to obtain employment in most industrial centers. Unfortunately, with all the improvements that have been made in the public school system, most boys and girls leave school without any adequate training for making a living. A few states have tackled this problem, with creditable results.

It is frequently said that the young men of today do not want to learn a trade. While there is some truth in this statement, it is only half the truth. Trade training has not generally been presented in an attractive way to boys and young men. When a definite effort has been made to interest them in apprentice training, the response has been very gratifying. The Milwaukee industries for many years have been a proof of this statement. Several of the large plants in Milwaukee have actually had to maintain waiting lists for their apprentice courses. Through cooperation between manufacturers and schools, much can be done to interest boys in trade training. American industries will need skilled men in the future, and they must take steps to provide adequate training.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Reciprocating Slide with Cam Mechanism for Operating Tool or Drill Slide

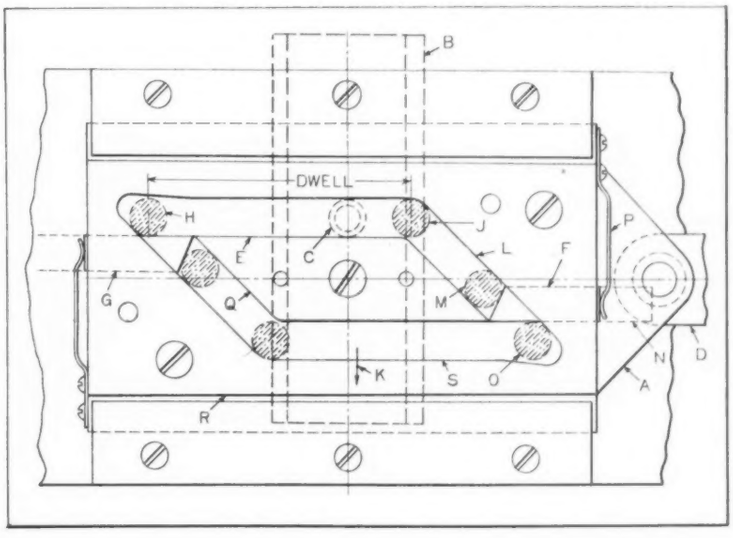
By JOHN A. HONEGGER

The reciprocating slide *A*, shown in the accompanying illustration, is driven by an eccentric connected to rod *D*. This slide has a cam mechanism by means of which motion is applied to the slide *B*. The motion of slide *B* is employed for feeding metal-cutting tools to the work. It can be applied to the spindle of a drill press, for example, to advance and withdraw the drill. By making suitable changes in the cam slot the drill can be given a rapid approach and reduced feeding movement, followed by a rapid return to the starting position and dwell. The movements required for this operation can be obtained by changing the cam-plate *Q* and guide plate *R*. These plates are secured in place by screws and dowels.

The cam-roll *C* is mounted on the driven slide *B*, which can move only in a direction at right angles to the movement of slide *A*. The cam slot *E* in slide *A* has latches or slides *F* and *G* which project into the slot and prevent the cam-roll from reversing its direction of travel in the cam slot.

When slide *A* is at its extreme right-hand position, the cam-roll will be located in the cam slot as indicated at *H*. The roll remains stationary while the slide *A* moves to the left until it reaches the position indicated at *J*, thus allowing the slide *B* to dwell. Any further movement of slide *A* to the left will cause roll *C* to move down the inclined portion *L* of the cam slot, moving slide *B* in the direction indicated by the arrow *K*. When the cam-roll reaches the point *M*, it forces the latch *F* back to the position indicated by the dotted lines at *N*. As soon as the roll reaches position *O*, latch *F*, under pressure from spring *P*, snaps back to the closed position. At this point, the eccentric that reciprocates slide *A* has reached its highest point and the slide commences to travel in the reverse direction. On the return stroke, the same cycle is repeated, causing the slide *B* to be returned to its original position when the cam-roll reaches the position indicated at *H*.

Within reasonable limits, the dwell positions of the cam slot, as at *S*, can be changed to produce any sequence of movements or dwells required.



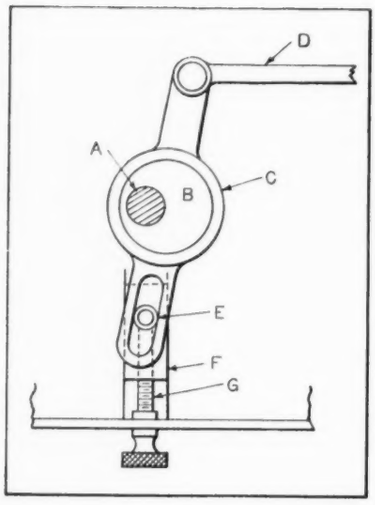
Reciprocating Slide Mechanism for Operating Tool-slide

Adjustable Feed Mechanism

By L. KASPER

The feeder slide on a wire machine is operated by the eccentric motion mechanism illustrated (see next page), which has an arrangement for varying the length of stroke while in operation. Referring to the illustration, the shaft *A* rotates the eccentric *B*, which carries strap *C*. The upper end of the strap carries an arm, the motion of which is transmitted to the slide through the rod *D*. The lower end of strap *C* has a slotted arm, which is positioned by the roller *E*. This roller is carried on block *F* which slides in a groove in the bed of the machine and is adjustable by means of the screw *G*.

The illustration shows the eccentric at its extreme right-hand



Adjustable-stroke Mechanism

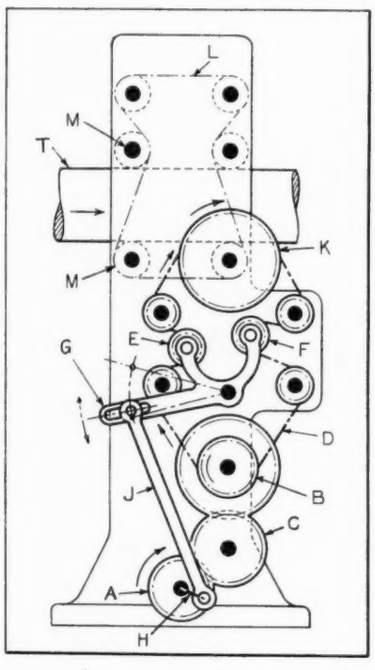
position. The arms on strap *C* gradually assume an angular position after the eccentric has passed the top center. The effect is that of a lever with *E* acting as the fulcrum, so that rod *D* has a movement greater than would be obtained by direct connection with the eccentric strap *C*. If the roller *E* is moved toward or away from the shaft *A*, the effective length of the slotted arm is increased or decreased; and as the length of the upper arm remains constant, its movement is accordingly increased or decreased.

Chain Feed Mechanism with Periodically Accelerated Motion

By PAUL GRODZINSKI

The accompanying illustration shows a mechanism used for feeding tree trunks *T* to a sawing machine with a periodically accelerated motion that might also be applied to other machines. This motion is obtained by an interesting arrangement for simultaneously taking up slack in one side of the chain while giving out slack in the other side. The mechanism is driven by the spur gear *A* which drives gear *B* by means of an intermediate gear *C*, thus driving chain *D* at a uniform speed. The chain is carried over four pulleys in the base of the mechanism. The pulleys *E* and *F* are attached to a swinging arm *G*. This arm is oscillated by a crank and rod mechanism *H* and *J*, also connected to the driving gear *A*.

The gear *K*, driven by chain *D*, imparts the periodically varying feed motion to the rollers *M*, in contact with the tree trunk, by a second chain drive indicated by the light dot-and-dash lines at *L*. If pulleys *E* and *F* remained stationary, the feeding motion would be uniform. However, as the pulleys are arranged on the periodically swinging lever *G*, the motion of chain *D* is changed in such a manner that it will remain stationary during one short period and will be accelerated or retarded in the other. The swinging lever *G* is slotted so that rod *J* can be adjusted to give the feeding motion required. A cam-actuated motion could be substituted for the crank motion obtained by crank *H* and rod *J*, the cam being given the profile necessary to obtain the desired motion.



Mechanism for Producing Periodically Accelerated Motion

Mechanism for Stopping Machine Automatically when Reel is Filled with Wire

By J. E. FENNO

The mechanism shown in the accompanying illustration is part of a machine for insulating electric wire. The purpose of this mechanism is to automatically disengage the machine clutch and thus stop the machine when the reel upon which the finished wire is being wound has been filled. This leaves the operator free to attend to other duties while the wire is being wound on the reel.

As the wire reel *A* gradually becomes filled, the roll *B*, resting on the layers of wire, is forced outward, causing the arm *C*, through a sliding clutch mechanism, to disengage the power actuating the reel. The roll *B* is held snugly against the wire by means of a weight (not shown) connected to the arm *C* by the cable *Y*.

The driving shaft *D* for the reel is supported in bearing *E* bolted to the machine base *G*. On this shaft is shrunk the clutch member *H* which engages the clutch teeth on sleeve *J*, to which gear *K* is keyed. Gear *K* meshes with gear *L* keyed to the shaft *M* on which the reel is secured. Sleeve *N* is a free fit in bearing *F*, and at its right-hand end has a turned collar. One end of coil spring *O* is placed in a hole drilled in the end of bearing *F*. This spring, when released as explained later, serves to rotate sleeve *N* in bearing *F*, so that the screw pin *P*, engaging a cam slot *S* in the sleeve, causes the clutch to move axially, disengaging the clutch members *H* and *J*.

The latch for releasing the spring is shown at *Q*. This latch slides radially in the guide *R* cast integral with bearing *F*. The movement of this latch is controlled by the pin *U* which is riveted to the latch and engages the deep cam slot *T* in a projection on arm *C*. Arm *C* turns freely on drive shaft *D* and is prevented from moving axially by the sta-

tionary pin *V* which engages a segmental groove in its hub.

When in its lowest position, the latch engages the projection *I* on the hand-lever *W*, which is a free fit on shaft *D* but is kept from moving axially relative to sleeve *N* and shaft *D* by collar *X* pinned to this shaft. Incidentally, lever *W* is pinned to the end of sleeve *N* and must therefore rotate with it. Sleeve *Z* provides for an axial movement of shaft *D;* the shaft slides in the sleeve, but is prevented from rotating by a key engaging a spline in the shaft. This sleeve is part of a shaft which is connected directly to the driving motor shaft.

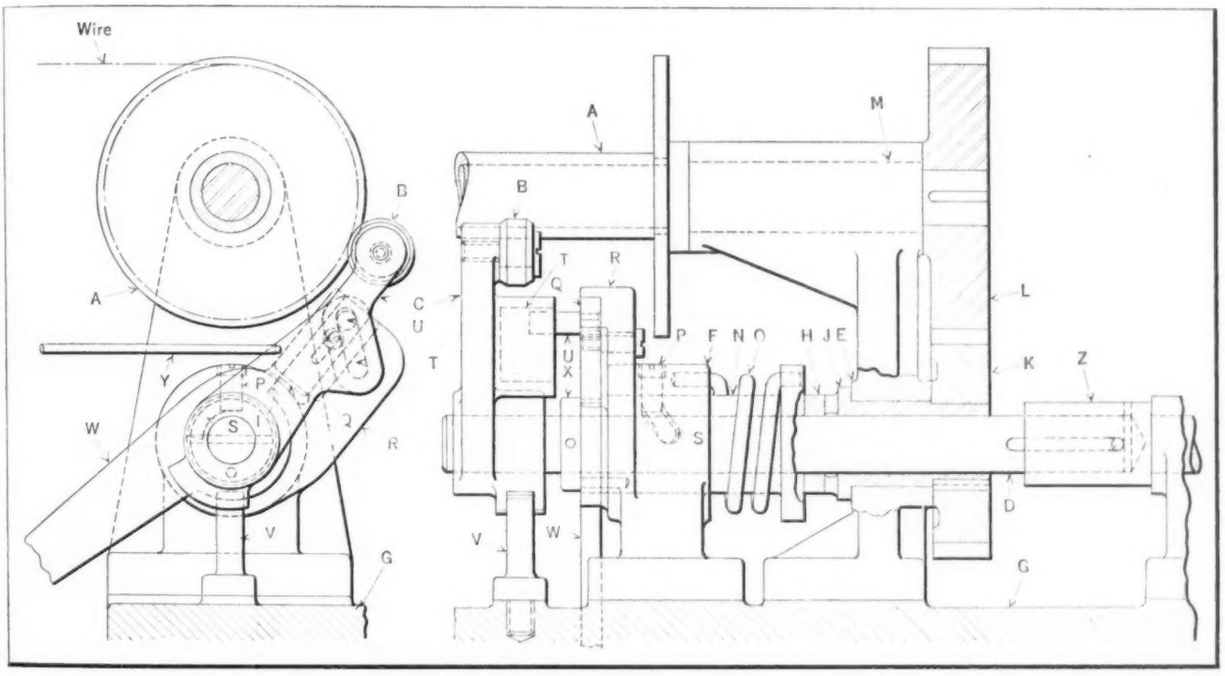
The wire passing on to a nearly full reel is indicated in dot-and-dash lines in the end view. At this time, the last layer of wire on the reel has forced the roll *B* and arm *C* very nearly to their farthest right-hand position. During this movement of the arm, the cam pin *U* has been forced outward radially until latch *Q* is just about to leave projection *I* on the hand-lever *W*. As soon as another layer of wire is wound on the reel, the lever *C* will swing to the right a corresponding amount and cam slot *T* will raise pin *U*, so that latch *Q* will be entirely disengaged from projection *I*.

It should be mentioned that a torque has been developed by the coil spring *O* which, up to this point, has held the projection *I* tightly against the latch. As soon as the latch releases the lever, the energy stored in the spring causes the lever to swing in a clockwise direction, rotating sleeve *N* until pin *P* comes into contact with the opposite end of cam slot *S*.

It is obvious that the action of the pin in this slot will cause the sleeve, together with lever *W*, shaft *D*, and clutch member *H*, to move axially toward the left and thus disengage clutch member *H* from the clutch teeth in sleeve *J*. By disengaging these clutch members, the power is thereby disconnected from the reel, causing the latter to stop, so that it can be replaced by an empty one.

When the empty reel is in place, the hand-lever *W* is merely swung downward to start the reel rotating. This causes roll *B* to rest on the core of the reel and the cam slot *T* to allow pin *U* to move downward, so that latch *Q* once more engages the projection *I* and locks the lever in position. This downward movement of the hand-lever, of course, rotates the sleeve *N* so that the reverse action of the pin in the cam slot *S* occurs, moving the sleeve *N* toward the right and engaging the clutch members *H* and *J*, thus rotating the reel.

One outstanding feature of this arrangement is that there is no excessive end thrust on the bearing, a condition which is typical of mechanisms of this type.



Reel A of this Mechanism is Stopped Automatically when Filled with Wire which Forces Roller B Outward, so that Latch Q Releases Sleeve N, Permitting Torsion Spring O to Revolve Sleeve N. This Causes the Pin P in the Helical Slot S to Slide the Clutch Member H out of Mesh with the Clutch Sleeve J, thus Disconnecting the Drive from Shaft D to Reel A Through the Gears K and L

* * *

We cannot regain prosperity by spending alone; there is only one road—productive work.

How Steel Rule Cutting Dies are Made

By ROBERT F. SALADE

FOR many years, steel rule cutting dies have been used extensively for the production of a great variety of paper and paper-board cut-outs from printed and lithographed sheets. These cut-outs are made in thousands of odd and fancy shapes. The work includes original color-printed designs for such advertising matter as wall and desk calendars, labels, cardboard fans, menu cards, desk blotters, package seals, gummed stickers, window placards, and a wide range of window display material. Among comparatively new lines of cut-outs are pictorial greeting cards and holiday folders, bridge tallies, odd-shaped posters and hangers, pictorial cardboard toys and novelties, and special cut-out covers for booklets, brochures, catalogues, and souvenir programs.

The cut and creased shapes for all kinds and sizes of folding paper boxes, cartons, and display containers are produced with steel rule cutting and creasing dies. These dies are set up in practically the same manner as steel rule cutting dies. The same kinds of material are used; the same methods of diemaking are followed.

Purposes for which Steel Rule Cutting Dies are Used

On account of their economy, wide application, long life, and ease of operation, steel rule cutting dies are being utilized today in many manufacturing industries besides the printing, lithographing, and paper box industries. New uses for these dies are being discovered constantly. Among the wide variety of flat or sheet material now being cut out to desired shapes or patterns with steel rule cutting dies, worked on heavy platen presses, are leather, thin tin, soft wood, composition wallboard, celluloid, cloth, rubber, cork, asbestos, corrugated paper-board, cardboard, parchment and vellum, metal foil, thin copper, rawhide (of the type used for belt laces), soft zinc and lead, linoleum and oilcloth, canvas, metal-faced paper, gelatin, glassine and cellophane.

Included among the well-known manufactured lines produced with the aid of steel rule cutting dies are cork, rubber, and asbestos gaskets; lithographed thin tin toys; celluloid advertising novelties; samples of fabrics; leather goods; inlaid patterns of linoleum floor coverings, and rubber goods.

How Steel Rule Cutting Dies are Applied

For all kinds of paper, cardboard, paper-board, celluloid, sheet rubber, and many other types of sheet material suitable for making cut-outs, steel rule cutting dies, single or multiple, locked up in a chase (like type), can be worked either on a regular platen printing press with its inking rollers removed or on a platen cutting and creasing press. In either case, the platen of the press to be used should be fitted with a removable steel plate about 0.035 inch thick. This steel platen acts as a smooth, hard counter in contact with the edges of the cutting die each time an impression is taken on the press. The platen of the press can be adjusted to provide for the thickness of the material to be cut; in fact, with one setting of the platen, any thickness of material can be cut out as required—that

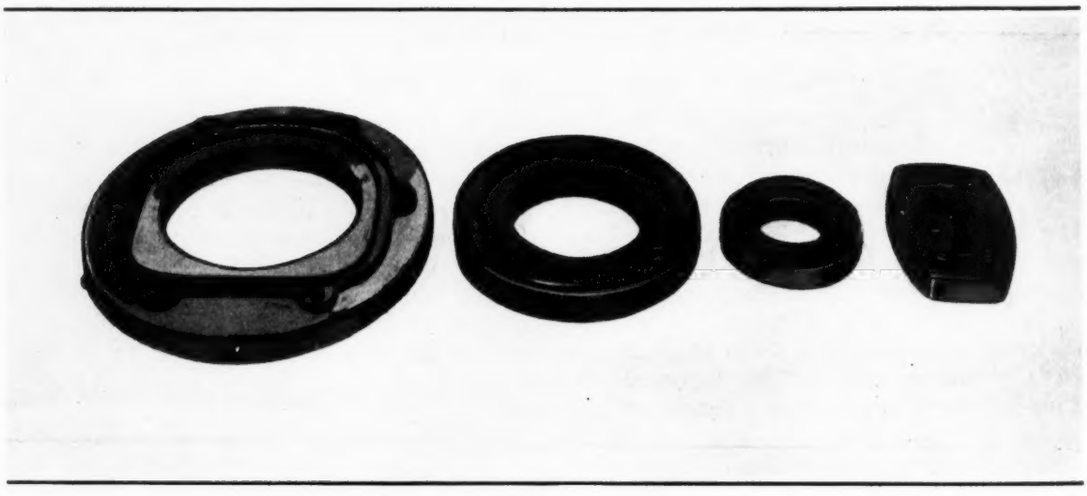


Fig. 1. Special Wood-base Steel Rule Cutting Dies for Cutting Gaskets

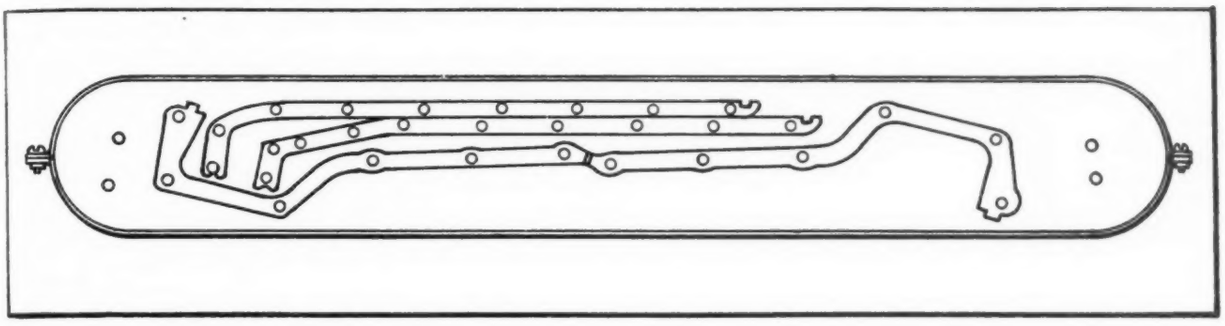


Fig. 2. Steel Rule Cutting Die Made for Cutting out Four Automobile Gaskets at One Time. The Steel Cutting Rules and the Steel Punches are Inserted in a Block of Laminated Lumber

is, any thickness of material ranging from sheets of paper stock up to paper-board and other sheet material 0.070 inch thick, and even greater when the cutting die has been constructed to cut soft types of extra thick material.

"Gang forms" of duplicate cutting dies can be worked both on large, heavy platen presses and on flat-bed cylinder presses. In die-cutting on a flat-bed cylinder press, the impression cylinder of the press is fitted with a special curved steel jacket which serves as a counter when in contact with the edges of the dies. As a general rule, however, only sheets of paper stock, cardboard, and flexible sheets of paper-board can be die-cut on a cylinder press. Special makes of steel rule cutting dies and heavy stamping presses are used to die-cut such materials as rawhide, wallboard, thick leather, asbestos, etc.

Material Used in Making Steel Rule Cutting Dies

To provide for the making of all styles and shapes of cutting dies, steel cutting rule is manufactured by a number of companies in various body thicknesses, tempers, and heights. The standard body thicknesses are 1, 2, 3, 4, 6, 8, 10, and 12 points (type point system; one point equals approximately 0.014 inch). All these are made in two types of cutting face, namely, center face and side face. The usual four standard tempers are: Extra hard; hard; soft; and dead soft. The two most popular heights of all makes of steel cutting rule are 0.923 inch and 0.937 inch. Other heights are made to order.

The 2-point body of steel cutting rule, with center face, and in the 0.923 inch height, is used to the largest extent in dies for cutting paper, thin paper-board and other thin, soft material. The 0.937 inch height of 2-point rule, center face, is used in dies for cutting cardboard, chip-board, folding box-board, and other soft materials up to 0.040 inch in thickness. The 3, 4, 6, 8, 10, and 12 points body thickness of rule, both center face and side face styles, usually of the 0.937 inch height, are used in dies made to cut various hard and thick materials. For example, a die made with 8-point body rule is strong enough to cut out shapes from heavy cloth, celluloid, rubber, cork, thin wood, corrugated board, thin sheets of tin and copper, asbestos, and leather.

Cutting dies made with center face rule will not cut certain thick materials as cleanly and sharply as dies having rules with side face. Nevertheless, dies with center face rules are quite suitable for cutting numerous kinds of material in a satisfactory manner. Dies built with 8-, 10-, or 12-point body rule, side face, are excellent for cutting out either straight-line or rounded odd shapes from thick paper-board like that used for large illustrated window displays; felt; thick sheet rubber; thin soft wood; and thin laminated board. New makes of steel cutting rule include 2-, 3-, 4-, and 6-point body, made with an extra long side-face bevel.

The extra hard and hard tempers of steel cutting rule are used not only for straight-line sections of "fancy" shapes of dies, but also entirely for such straight-line forms of dies as keystone, Latin cross, diamond, triangle, square, oblong, square with angle corners, hexagon, and octagon. The extra hard and hard tempers of rule can also be bent to any angle up to 45 degrees. No special heat-treatment is necessary for these grades of rule before they are placed in dies.

Soft steel and dead soft steel cutting rules are employed for curved, round, and other rounded shapes of cutting dies. The soft steel rule can be bent readily to almost any odd shape, but for the most intricate shapes, including small round patterns, "waves," and the like, the dead soft steel rule can be bent to the greatest advantage. After having been bent to odd shapes, and before being placed in dies, both soft steel and dead soft steel cutting rules must be heat-treated and tempered hard.

There are various methods of bending the strips of soft steel or dead soft steel to the required shapes for dies. The simplest method is the use of a flat-jaw bench vise and a pair of pliers. In large diemaking plants, the mechanical equipment includes a hand-lever steel rule cutter, a patented make of steel rule bending press, and an assortment of hard steel stock male and female dies for use in the press. By means of these sets of stock

dies and pressure from the rule bending press, strips of soft steel rule, of any body thickness, can be bent accurately to any shape. It is also an easy matter to duplicate the same bent shape of rule in any number of pieces, as may be required for either single or multiple dies.

Hardening and Tempering the Pieces for the Dies

The methods of hardening and tempering the bent pieces of soft steel or dead soft steel cutting rule are as follows:

The essential equipment for this work is simple and inexpensive, consisting of a gas flame (a Bunsen burner, or an ordinary gas jet); a deep metal pan, large enough to receive all sizes and all shapes of the bent pieces of rule to be handled; a supply of tempering oil of any well-known make; a pair of tongs; a steel plate, about 9 by 12 inches, 3/32 inch thick; two insulating bricks (Celite); and a quantity of fine sawdust and a stiff-bristle hand brush, both to be used in cleaning the heat-treated rule.

With the aid of the tongs, the diemaker holds each piece of bent soft steel rule over a Bunsen burner or gas jet, until the rule is heated to a cherry red. In numerous cases, several pieces of bent rule can be heated at one time. The heated rule is immediately quenched in a bath of tempering oil which is placed in the metal pan referred to. The next step is to clean the treated rule with the stiff-bristle brush and the fine sawdust. This cleaning process removes oil and scale from the rule, especially from the cutting edge.

Now the steel plate is heated to a cherry red color, the diemaker holding it with the tongs over the Bunsen burner or gas jet, and then placing the red-hot plate on the two insulating bricks. Working rapidly, the diemaker sets the hardened and cleaned pieces of rule, cutting edge up, on the surface of the hot steel plate for tempering. A number of pieces can be placed on the plate at the same time. The rule should remain on the plate until the rule becomes a straw color clear up to the cutting edge. The tempered rule is then removed from the plate and allowed to cool in the air.

Procedure in Constructing the Dies

Steel rule cutting dies are set up in two different styles of construction: One is with the rules inserted in a mortised block of five-ply laminated birch lumber. The other style is known as all-metal construction, the rules being set up and held in the proper position with printers' spacing material, such as iron or lead furniture, type quads and spaces, 6- and 12-point lead slugs, 2-point leads, and 1-point brasses. By the systematic use of this spacing material, it is a comparatively easy matter to set up and "blank out" straight-line cutting dies; and even dies of fancy or intricate shapes can be tightly constructed and locked up in a chase like a form of type. It is also possible to set up all-metal cutting dies by the use of linotype blank slugs, cut to desired lengths to fill in the open space in the dies.

Laminated birch lumber is the highest grade of wood obtainable for making self-contained steel rule cutting dies, either single or multiple. Laminated board is supplied in standard block size, 24 by 36 inches, as well as in various widths from 3 to 10 inches and 24 inches long. One large die can be set in a properly mortised block of the 24- by 36-inch size or a number of smaller duplicate dies can be set in a block of the same size. Smaller sizes of blocks are used, of course, for dies of small size.

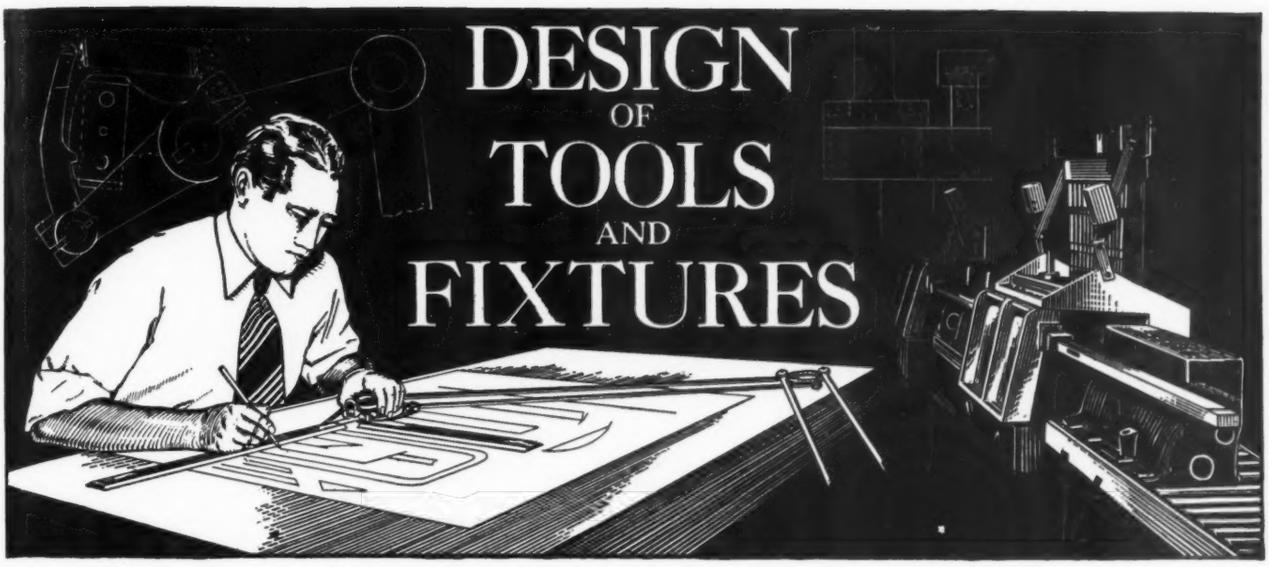
In cases where long runs of sheet material are to be die-cut with a "gang form" of duplicate dies on flat-bed cylinder presses, a number of laminated board blocks can be used, each one containing one or more dies. The blocks can be placed side by side and locked up together as one complete form for the press. The self-contained dies can be used over and over again for repeat runs of the same work.

To provide not only for the various heights of steel cutting rule, but also for cutting many different thicknesses of material, standard five-ply laminated birch lumber is supplied in seven different heights: 1/2, 5/8, 11/16, 3/4, 13/16, 7/8, and 15/16 inch. Blocks of selected heights and sizes for the dies to be made are first marked on the top surface with a lead pencil for the pattern or shape to be mortised. The penciled lines are to indicate accurately where grooves are to be cut in or entirely through the block to permit insertion of the rule. The mortising is done with either a hand keyhole saw or a jig saw. The grooves must be sawed wide enough to accommodate the body thickness of the rule to be inserted. However, the rules should fit into the open grooves tightly. They can be tapped in gently with the aid of a small block of hard wood and a mallet. When paper, cardboard, or other thin material is to be cut with either an all-metal die or a laminated wood and steel rule die, small pieces of cork should be glued on the blank spacing material near both sides of all cutting rule. The purpose of the corks is to push off the cut sheets of stock easily from the die.

* * *

Welded Tubular Railing

An interesting development in tubular railing for industrial and other applications has been made by the Fabricated Steel Products Co., Wheeling, W. Va. These railings are assembled by welding and have jointless steel posts in place of the usual tubular fittings. For stairway railings, the posts can be cut or mitered accurately at the factory, so that they can be welded to the steel work of the structure, eliminating all other types of fastening. More attractive appearance and greater strength and rigidity are claimed for this method of constructing railings.



Radius Grinding Fixture for Milling Cutters

By RALPH R. WEDDELL, Rockford, Ill.

Milling a radius, particularly one of large dimensions, involves the use of a milling cutter, the sharpening of which often presents a difficult task. For small radii, a formed solid cutter may be used which is comparatively easy to sharpen. The accurate form given a small cutter is retained indefinitely by merely grinding across the gash of the cutter, the same as in sharpening formed cutters such as are used for cutting gear teeth and for fluting.

For large cutters, inserted blades must be used. The radius is rough-formed in the blade either before or after assembly in the cutter housing. The

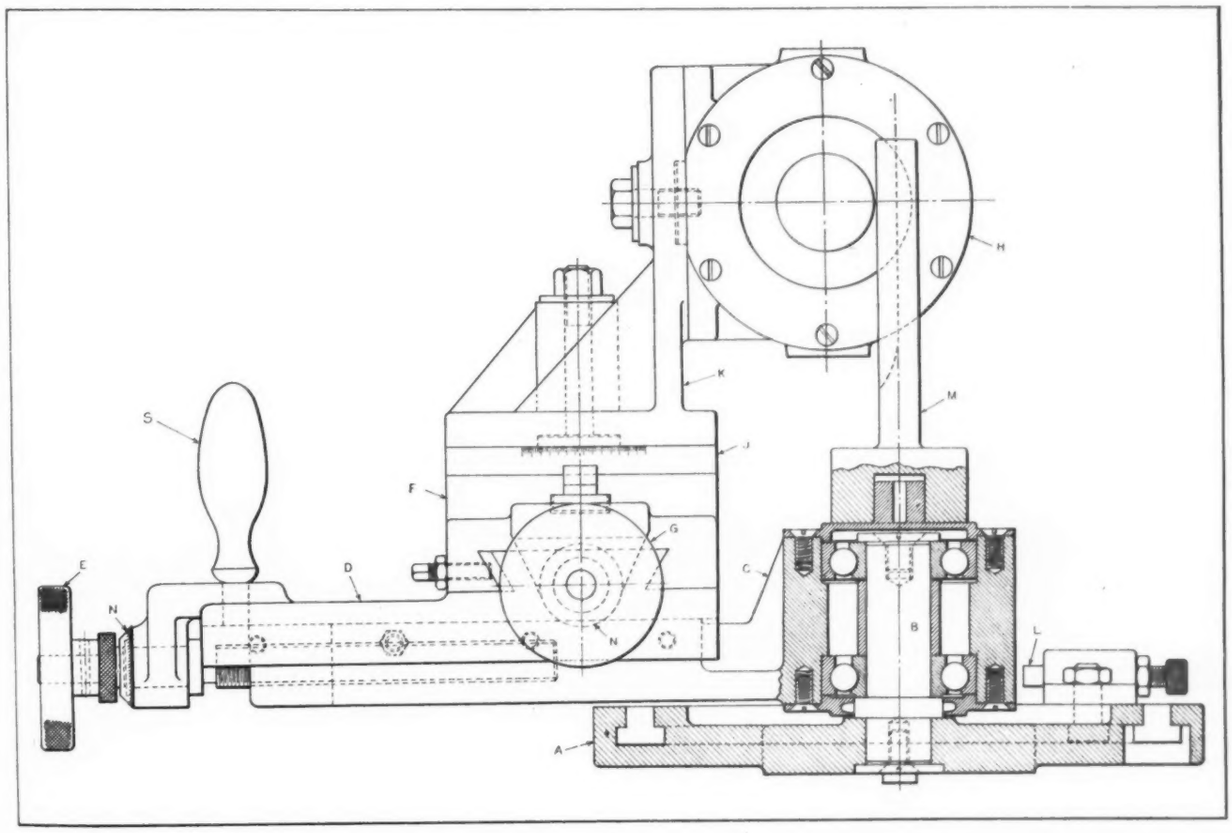


Fig. 1. Fixture for Radius-grinding Milling Cutters Designed for Use on Universal Tool and Cutter Grinder

correct clearance angles are accurately formed in the cutter blades by grinding after they are assembled in the cutter body. When dull, the latter operation must be repeated to sharpen the cutter.

Several adequate fixtures for grinding smaller cutters on universal tool and cutter grinders are offered commercially. However, for larger as well as smaller cutters, a substantial and very easily operated fixture is shown in Figs. 1 and 2. The adaptability of this fixture and its free rotation, which permit the operator to generate an evenly formed curve through the complete circle he is grinding, are features of the design.

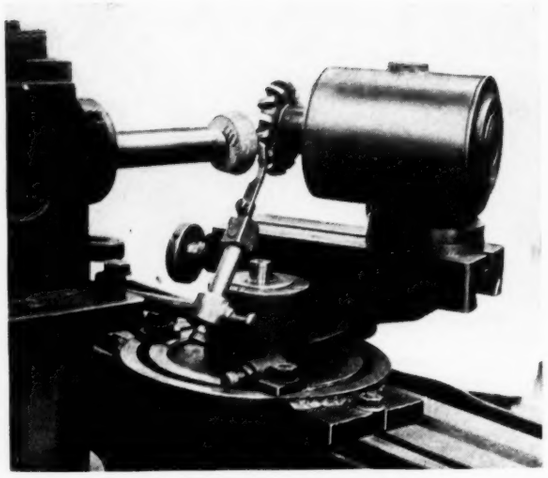


Fig. 2. Fixture Shown in Fig. 1 Set up for Grinding Staggered Tooth Cutter

The circular base *A* is clamped to the table of the universal tool and cutter grinder. A center pin *B* carries two single-row radial thrust ball bearings, which are secured in the dustproof swing housing *C*. An adjustable double slide member *D* fits the dovetail slide in the swing housing, and can be adjusted in a radial direction by the handwheel *E*.

The T-slotted cross-slide *F* can be operated in a transverse direction by the handwheel *G*. This cross-slide moves in the cross-dovetail slide at the top of the double slide *D*. A universal ball-bearing work-head *H* may be fitted to the T-slot of the cross-slide *F*. Full universality is imparted to the head by the circular sub-base *J* and bracket *K*, both of which are marked in degrees.

The arc of swing of the fixture is adjusted by the spring stop-dogs *L* which can be set to any circular position in the circular T-slot of the base. The ball bearings permit the whole assembly to swing freely when operated by means of the handle *S*.

The set-up for a staggered tooth cutter, which is the most complicated type, is shown in Fig. 2. The cutter shown here has been circular-ground to the correct width and diameter. When located on the arbor in the work-head, the cutter is brought against the removable setting gage *M*, Fig. 1. This positively locates the axis of the cutter relative to the center of rotation of the fixture.

Removal of the setting gage permits the cutter to be moved over so that it can be swung from any center relative to itself by means of the handwheels *E* and *G*. Accurate adjustment is obtained by the micrometer collars *N*. The cutter can be set so that either convex or concave surfaces can be ground. The locating finger on the under side of the tooth is set for clearance, as in grinding other cutters.

While the illustrations show the fixture fitted with a universal work-head, the T-slot in the top slide can be fitted with centers for locating and holding cutters, end-mills or reamers while grinding to a quarter radius. The fixture can also be used for dressing grinding wheels. A bracket with a truing diamond located by a gage can be mounted on the top slide and used for forming concave or convex surfaces on grinding wheels by swinging the fixture about the center pin.

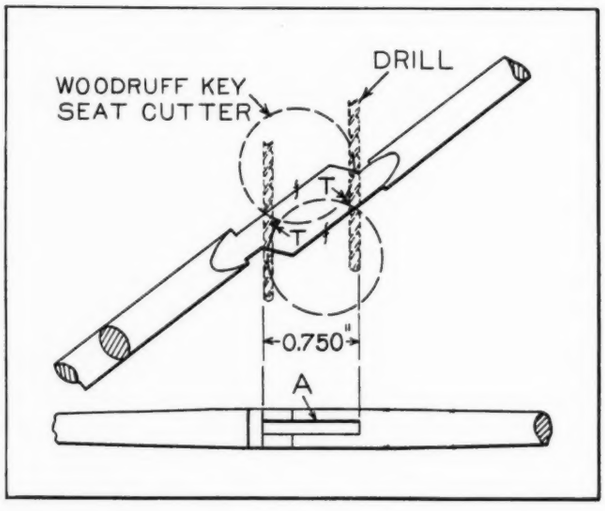


Fig. 1. Diagram Showing Method of Rough-machining Slot A with Milling Cutter and Drill

Indexing Die for Finishing Small Slots

By J. DECKER, Camden, N. J.

The die illustrated in Fig. 2 is used in finishing the small rectangular slot *A* in the part shown in Fig. 1, which is made of S A E 1045 forged steel. The drilling and milling operations by means of which the slot is rough-machined previous to the finishing operation are indicated in the upper view, Fig. 1. The slot *A*, which is 3/32 inch wide, passes through the piece at an angle of 36 degrees.

The specifications call for a smooth highly finished slot, which was obtained by running two shaving punches *B* and *C*, Fig. 2, through the slot, one punch succeeding the other. The first punch *B* removes the material at *T*, Fig. 1,

which is not removed by the previous operations, and the second punch *C* finishes the slot to the required size. In order to permit finishing one piece at each stroke of the press, the tool was made with two working stations. The punch *B* is located at the front station of the die, as shown in Fig. 2, the work being located in the position indicated by the heavy dot-and-dash lines. The finishing cut is taken by the punch *C* at the rear of the die, the work-holding member being indexed after each stroke. The position of the work at the rear of the die for the finishing cut is indicated by the light dot-and-dash lines.

The principal parts of the die are the punch-holder *D*, the stationary base *E*, the indexing table *F*, and the locating block *G*, mounted on the indexing table. The work is clamped against the block *G* and held in position by locating lugs or projections milled on the faces of block *G*. The clamping device consists of the parts *H*, *I*, and *J*.

The punch-holder carries the punches *B* and *C*, which are held in place by clamping blades *K*. The punch member is provided with two guide posts *L* which assure accurate alignment of the punches with the indexing table *F*. Preliminary indexing is obtained by the ball, spring, and notch arrangement shown at *M*. In order to prevent the punches from buckling, guides *N* are located near the point where they enter the work. These guides are subjected to a downward pressure by springs *O*.

Slots *P* are cut through the indexing table *F* at an angle of 36 degrees, in order to clear the lower part of the work. Pins *Q* limit the travel of the punch guides when the press slide is in the upper position. Notches in the bushings *R* clear the projecting pins. The punch-holding member *S* is assembled in member *D*, and the depth adjustments made necessary by grinding the punches are obtained through shims *U*. The center of the stationary base *E* is bored out sufficiently to allow the chips

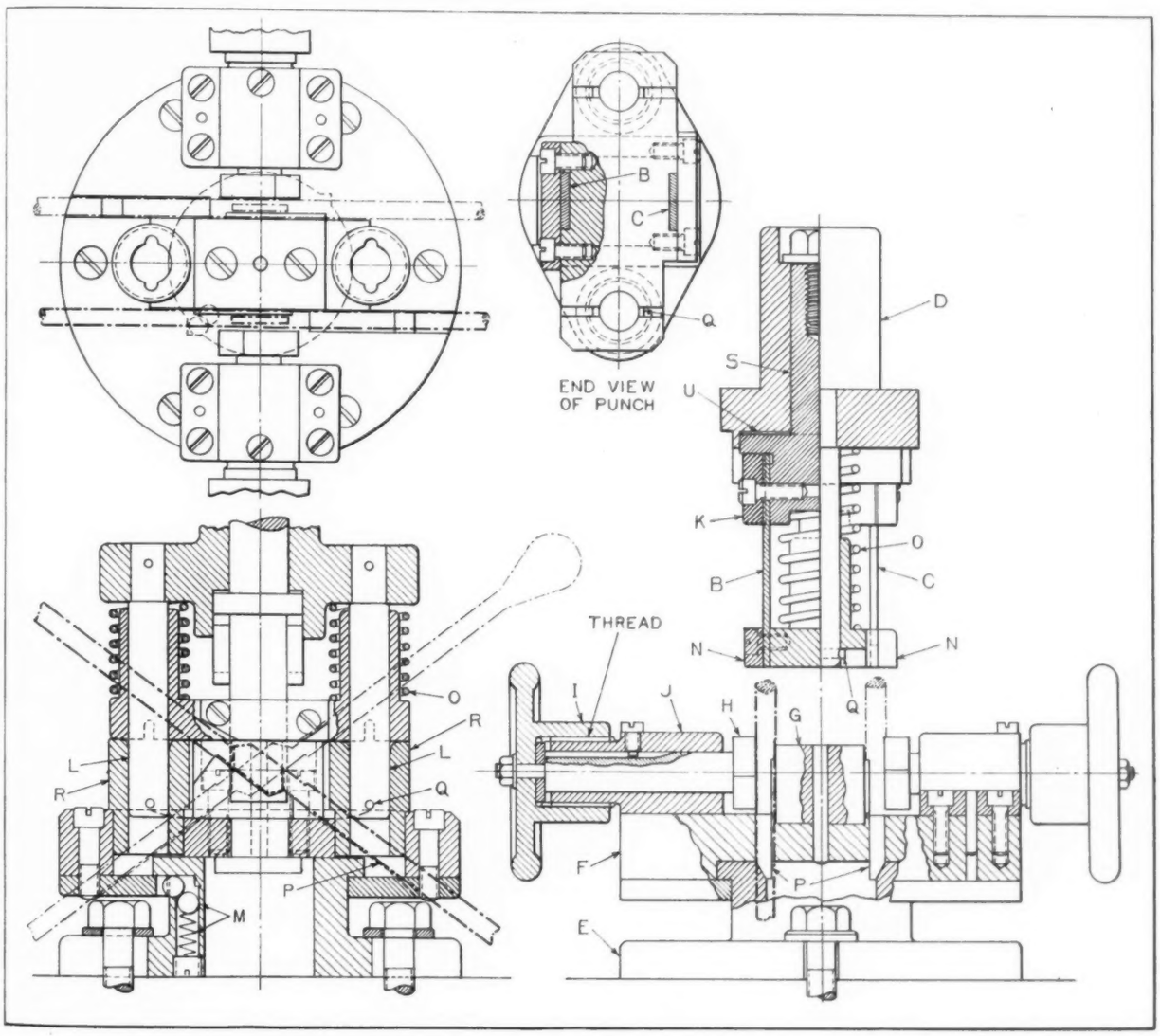


Fig. 2. Die Equipped with a Punch B for Removing Metal at T from Slot A, Fig. 1, and a Punch C for Finishing the Slot, the Work Being Indexed from One Position to the Other

or shavings to drop through. Block *G* and the punch-holder are so designed that punches for slots of a different size can be used.

A piece to be finished is put in the front station and clamped by turning the handwheel *I*. The press is then tripped; after the up stroke of the tool, the work-holding base is indexed, so that the piece is located under the rear or finishing punch *C*. The front station is then loaded and the press again tripped. The tool is now indexed, bringing the finished piece to the front position, where it is replaced by a new piece, after which the cycle of operations is repeated. Thus a finish-slotted piece is produced at each stroke of the press.

In order to prevent the press from being tripped while the tool is being indexed, an interlocking arrangement is provided. This makes it impossible to injure the tool through a false or accidental move. It has been found that by chromium-plating the punches their life can be prolonged about five times.

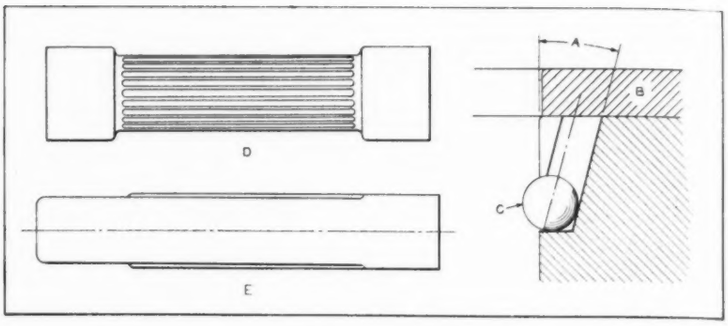


Fig. 2. (D) Corrugated Work; (E) First Operation on Shell D; (C) Ball Used in Die for Producing Corrugation

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Corrugating Drawn Shells with Dies Using Steel Balls

By WARREN P. WILLETT, Plantsville, Conn.

For ornamental or structural reasons, or for both, drawn shells and drums are frequently required to have longitudinal corrugations along the sides. The method of producing these depends on the size of the article and the proportions of the corrugations. In some cases, they may be rolled in with a pair of fluted rolls in a rotary machine, while in other cases, they may be produced by means of a corrugating die in a power press.

If the material is of light gage and the corrugations uniformly spaced and of small pitch, the rolling method may be preferable. Under other conditions, the use of dies would be more desirable—especially if the volume of production is great. Corrugating is usually an intermediate operation and, in the case of an open-end shell, it may be done before the bottom is removed from the stamping. If the corrugations run the entire length of the shell, the die is simple and without any unusual features.

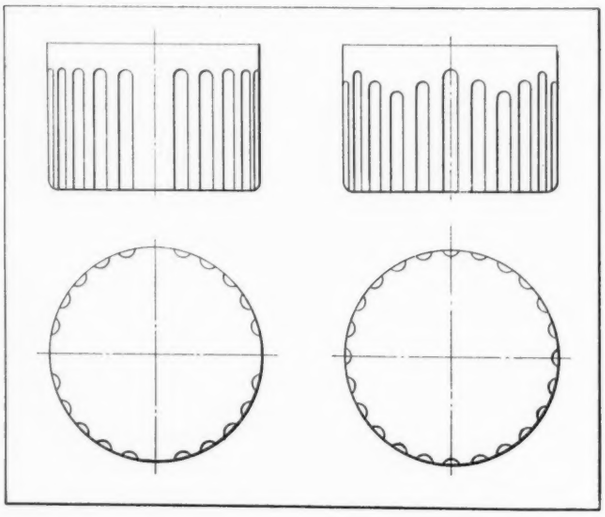


Fig. 1. Examples of Shells Corrugated in Press Die

In the case of the drum shells shown in Fig. 1, the corrugations do not run the entire length, and consequently, the work is pushed into the die the required depth and then backed out. An ordinary corrugating die may operate fairly well on work of this kind, but there is risk of distorting or tearing the work in forcing it back through the die. A better die for this class of work is one in which steel balls are set into the ring at an angle, as shown in the view to the right in Fig. 2, for use as the corrugating medium. The punch is of the usual solid construction with grooves machined along the sides.

The steel balls in the die ring are not held rigidly in place, but are loosely inserted in pockets milled in the die ring at a slight angle to the axis of the die wall, as shown in the cross-section, Fig. 2. When the ball *C* is resting at the bottom of the pocket it projects inside of the die wall the distance required to force the metal of the shell into the grooves of the punch as the punch is pushed into the die. As the punch is withdrawn, the balls retract upward and outward, thus relieving the side pressure and facilitating the removal of the work. The angle *A* of the side of the pocket should be about 15 degrees. The ring *B* retains the balls in the pockets and also serves as a gage for centering the work in the die.

The shell shown at *D* has corrugations that do not extend to either of the expanded ends. The method of producing this result is to first draw the shell with the bottom end reduced to the bottom diameter of the corrugations. The large diameter of the shell is next corrugated the desired distance, as shown at *E;* then the closed end is trimmed off and both ends are expanded to the required size by a rolling operation.

Aluminum in the Shop Equipment Industries

The Process that Made Aluminum Available as a Commercial Metal was Discovered Fifty Years Ago This Month. To Commemorate this Important Event, It Seems Fitting to Review the Present Uses of Aluminum in Machine Tools and Shop Accessories

WHILE machine tools account for only about two per cent of the machinery business in the United States, the conditions in the machine tool industry are closely watched, because whenever there is a demand for machine tools, it is an indication of general industrial activity. It is safe to conclude that there are better times ahead, because the 1935 machine tool business was much greater than for several preceding years, and machine tool orders are now well above a fifteen-year average. The limited buying of new equipment during the last few years makes replacements at the present time almost imperative.

The Machine Tool Show in Cleveland gave ample evidence of this replacement activity. It was said that, on an average, over $300,000 worth of machine tools were sold each day of the Show. The improvements in the machines on display were noteworthy as regards both the design and the materials used. One of the obvious changes was the more general introduction of aluminum in machine tool construction. This metal, so widely used in other fields, has not, in the past, been considered as applicable to any great extent in shop equipment construction, and it was, therefore, astonishing to find how widely it is now being used for many parts of machine tools. Its future possibilities are such that they also deserve attention at this time.

Applicability of Aluminum to Machine Tool Parts

A machine tool must have rigidity and must be free from vibration. Cast iron, steel, bronze, and brass are the materials that have been almost exclusively used in the past, but experience has proved that aluminum can be used advantageously for many parts. Aluminum castings have a modulus of elasticity of 10,300,000 pounds per square inch, compared with from 11,000,000 to 15,000,000 for various types of cast iron; hence sufficient rigidity can be obtained with aluminum at a saving of about 60 per cent in the weight.

The lightness of aluminum is of great advantage, particularly in reciprocating or overhanging units. The strength of the metal depends on the alloy used; the strength of aluminum alloys is much greater than that of pure aluminum. Furthermore, pure aluminum is not easily cast and its mechanical properties in the cast form are not satisfactory. But just as the properties of iron are improved by the addition of carbon and other alloying elements, so the addition of suitable hardening agents to pure aluminum materially improves the mechanical properties of the alloys, and aluminum casting alloys have excellent foundry characteristics as well. Hence the use of aluminum has greatly increased in all machinery industries, including the machine tool branch.

Some Examples of the Use of Aluminum in Machine Tools

At the present time, the use of aluminum in machine tools extends over a wide field. Let us first review briefly its use for machine tool parts that may be applicable to a variety of machines. This metal is used in parts for air and hydraulic chucks to reduce the inertia and facilitate starting and stopping. Aluminum clutch disks improve the performance of clutches; their long life is due to the fact that they dissipate heat easily.

Aluminum is frequently used on duplicators and pantographs, a number of which have all moving parts made of a high tensile strength, heat-treated aluminum alloy. On duplicator tables, aluminum lightens the weight, makes the table extremely sensitive, and at the same time enables it to be easily lifted from the milling machine.

Link mechanisms are often made from aluminum. The operating arms for gear shapers, which reciprocate at a speed of 550 strokes per minute, are made from this metal. Chip pans of various machines are also made of aluminum, so that they can be more easily handled.

Other examples include splash guards around the bed of tool grinders; grinding disk mountings and parts for carbide tool grinders; high-speed attachments; and face-mill grinding attachments.

On high-speed machines, handwheels sometimes revolve rapidly, and it is desirable to eliminate the flywheel effect as far as possible by using aluminum. The appearance of the metal eliminates expensive finishing operations. Often the pulleys for V-belt drives are made of aluminum.

The handling of heavy parts of machinery has been the cause of many injuries, among which hernia figures prominently. The lightening of such parts as the bodies of dividing heads, which must be removed and replaced by hand, should contribute greatly to the decrease of this class of injuries.

Aluminum Used for Drilling Machine Parts

Aluminum parts are extensively used in drilling machine design. Radial drill parts made of this metal include traverse bracket plates, traverse pulley shaft supports, feed brackets, lever knobs, spindlle thrust bearing castings, main head castings, and a great number of covers.

The use of aluminum in drilling attachments means easier operation, higher speeds, better balance, less wear, and quicker set-ups. The metal is used for multiple-spindle heads and tapping attachments. The heads of drilling and tapping machines are also sometimes made of aluminum castings.

Application of Aluminum to Milling Machines, Shapers, and Automatics

Milling machine gear housings and arbor supports have been made of aluminum for some time. An interesting application is found in large gearcase covers made by one manufacturer. These covers, formerly made from cast iron, were 1/2 inch thick and weighed more than 200 pounds each. They had to be handled by a crane. By making the covers of aluminum, the thickness was reduced to 5/16 inch and the weight to 55 pounds. They are now easily handled by one man.

Rams, heads, and rocker arms of shapers are made of aluminum to reduce the inertia and increase speeds. One of the shapers so equipped has a speed of 200 strokes a minute—appreciably higher than that ordinarily used. The ram bearing of this shaper is aluminum on cast iron and steel, the rocker arm is cast aluminum with bronze bushings for the pivots, while the crankpin block is of hardened steel running directly on aluminum.

The problem of weight reduction to reduce vibration at the higher speeds now employed has engaged the attention of manufacturers of automatic screw machines. Attachments on high-speed spindles can be balanced more easily if their weight is reduced. Aluminum has been used for a number of screw machine parts, including stock rings, yoke rings, thrust collars, bushings, finger holders, and thrust plates.

Aluminum for Portable Tools, Hoists, and Miscellaneous Applications

The importance of aluminum in portable tools hardly needs discussion. Lightness is the first essential of such tools, since one man usually holds and operates them, often carrying a tool from place to place many times during the working day. Portable tool manufacturers early employed aluminum for such equipment. Numerous applications of aluminum are to be found in the holders for gages and other instruments. All-aluminum hoists have been in use for some time. They are much lighter than other hoists, and when the right alloys are used, they are just as strong.

Machines having a relatively slow motion, such as forging machines and bulldozers, offer fewer opportunities for the use of aluminum. Yet aluminum clutches, castings for gear covers, and handwheels are used on a number of forging machines. The operating arms and rocker arms of presses have also been made from aluminum.

Aluminum May Be Used to Improve Shop Lighting

Good lighting is important in any plant; it is more so in machine shops where the eyes are focussed all day on precise work. Painting the walls with aluminum paint promotes good lighting; but it is even more important to use proper light-reflecting surfaces for the lamps used in the shop. These are often aluminum-painted because of the ability of this coating to diffuse light. An even better reflecting surface is found in Alzak reflectors, which are made from aluminum and subjected to an electrolytic brightening and protective treatment which gives the metal a reflectibility higher than that of many other reflectors. These reflectors do not tarnish. They can be cleaned periodically with soap and water without injury to the reflecting surface.

Aluminum paint as a protective coat for steel and wood, concrete, stone and brick, is a well-known application, and is used not only for plant exteriors and interiors, but for equipment and machinery.

Some Possible Future Applications of Aluminum

The future possibilities for aluminum in the machine tool industry are as great as or greater than the present applications. It would be impracticable to use aluminum entirely, because frequently dead weight is needed to improve the performance of a machine tool. The cost would also be increased. Hence aluminum is used only where its properties justify the increased cost, and no attempt should be made to replace materials that serve the purpose of design and performance better than aluminum.

There are many applications where aluminum could be used to advantage, in addition to those referred to. Bodies of chucks for machine tools, in the larger sizes especially, could be advantageously made from aluminum. They would be easier to start and stop, and could be more easily changed because of their lighter weight. Since aluminum does not resist frictional wear as well as the

heavier metals, the wearing surfaces could be faced with hardened steel strips.

The rotating heads of automatic chucking machines are sometimes as large as 3 feet in diameter, and are constantly rotated and indexed. On turret type machines, the turret must slide back and forth and rotate at the same time. Here aluminum might serve a useful purpose. Its use would also considerably shorten the time consumed in handling removable parts in general, as well as large jigs.

In vertical broaching machines, large masses are constantly reciprocated. The heads are guided and supported on one side. If the overhanging weight were lightened, the surface wear would be decreased and it would be possible to speed up the machine.

The problem of overhanging weight again presents itself in the horizontal boring, milling, and drilling type of machine. Weight reduction here means faster operation, less counterweighting, and less wear of bearing surfaces. Lighter overhanging loads would also mean less deflection and greater accuracy. The back-rest, which must often be removed and replaced, and the table on this type of machine offer additional possibilities.

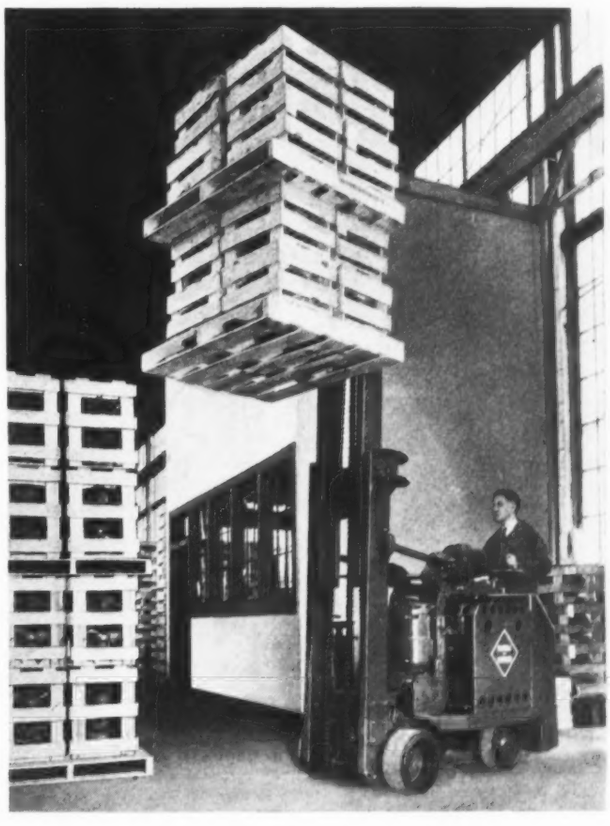
Die-sinking and diemaking machines are usually hand-operated. The lightening of heads, tables, and feed mechanisms would give better control and faster and easier operation.

In hobbing machines, over-arm supports, slides and other frequently moved parts, as well as heavy rotating heads, could be partly made from aluminum. In grinding machines, oscillating heads, fast reciprocating heads, and large high-speed swing-frame grinders offer opportunities for study. The reciprocating heads of honing machines afford similar opportunities. Even in the ordinary lathe, the carriage, tailstock, and steadyrests might at times be improved by being made lighter. A few other possible applications mentioned at random are arbor supports, hydraulic press rams, mounting rings of segment grinding wheels, and parts of high-speed vertical boring mills.

The Application of Aluminum to the Frames of Power-Driven Metal Saws

The reciprocating frames of power-driven metal saws could be made of aluminum. The pressure of the saw blade on the work is important and must be controlled. When the weight of the saw frame is used to apply the pressure, there is little justification for aluminum. In many cases, however, such as in cutting thin-walled tubing, the weight of the frame is far too great in ordinary saws, and pressure control is necessary to reduce, rather than increase, the pressure on the work. Sometimes, the pressure is removed on the return stroke. In such instances, aluminum would provide better control and would permit greater speed.

Predicting further future uses of aluminum in the machine tool industry is not so visionary as it may sound. In half a century, aluminum, which was a laboratory curiosity in the days of Abraham Lincoln, has risen to fifth place among the metals in point of world tonnage. It has invaded many diversified fields, and is today one of the most promising metals in industry. What the next fifty years may bring is problematical; but with the start that aluminum already has made in the shop equipment industry, it is safe to predict a greatly extended use in this field in the future.



The tiering truck enables maximum utilization of space in storage rooms, especially when pallets are used for supporting the crates, boxes, barrels, etc., that are being stored. The pallets seen in the illustration are only 2 3/4 inches high over all. They are constructed of inexpensive lumber. These pallets are made by the Elwell-Parker Electric Co., Cleveland, Ohio, for use in combination with fork trucks built by that concern.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

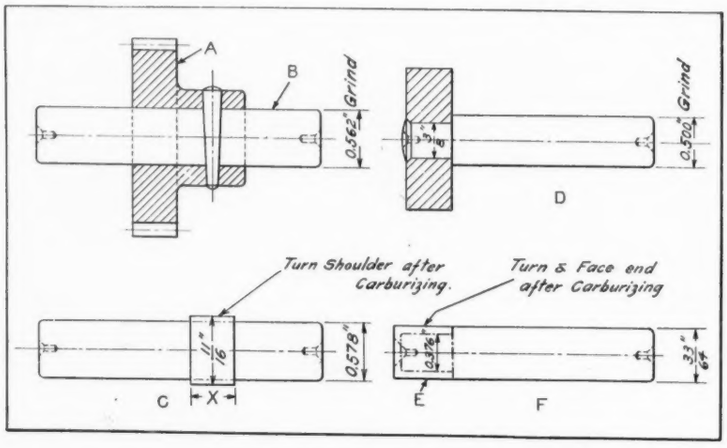
Assembling Hardened Steel Parts that Require Drilling and Riveting

In assembling hardened steel parts, it is often necessary or desirable to perform such operations as drilling and riveting. As it is practically impossible to drill or rivet hardened steel surfaces, some means must be employed to leave the metal soft at the points where these operations are to be performed or to draw the temper at these points after the parts have been hardened. The method used in the case of the parts shown in the illustration made it possible to perform the required operations easily without sacrificing the uniform toughness and hardness of the steel.

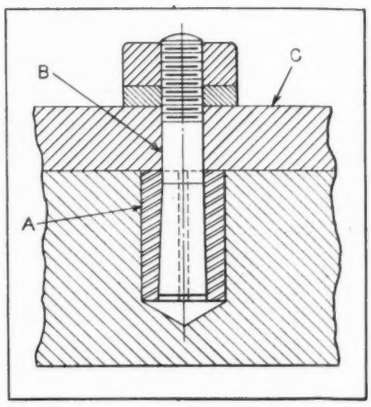
In the case of the gear *A* and shaft *B*, it is necessary to drill and ream the taper pin hole in the hardened shaft after the gear has been positioned on the shaft. The shaft is of cold-rolled steel, carburized, hardened, and ground. The following list of operations performed on these parts in the order given will make clear a method of assembling that can be employed to advantage for a great variety of machine parts. The shaft *B* is first cut to length and centered, after which it is turned to the dimensions shown in view *C* with a shoulder at the point to be drilled. The shaft is next carburized to a depth of approximately 1/32 inch. Then the shoulder *X* is turned off and the shaft is hardened. As the carburized shoulder is turned off previous to the hardening operation, the shaft will be soft at this point, thus making it possible to drill and ream the hole for the tapered pin.

The view at *D* shows a hardened and ground shaft riveted to a collar. In order to leave the end of the shaft soft for riveting, it is turned down, as shown by the dot-and-dash lines at *E* in view *F*, after carburizing and before hardening.

CHARLES GOEMAN
South Ozone Park, L. I.



Parts Requiring Drilling and Riveting Operations After Hardening



Method of Anchoring Hold-down Stud in Blind Hole in Die

Expansion Bolt for Reamed Hole in Hardened Steel

Recently the writer found it necessary to clamp several additional nest plates to a large die in which the only holes available for clamping bolts were two blind reamed holes. It was considered inadvisable to anneal the die and drill new holes because several sections of the die would be subject to warpage on rehardening. The method of fastening finally adopted proved so satisfactory that it has become standard practice in this shop.

The method employed is merely the application of the expansion bolt principle, as shown in the illustration. A bushing *A* with a shallow-taper bore and the outside finished with a coarse knurl was made, and then split, as indicated. A stud *B* was next turned with a taper to fit the bore in the split bushing. When these two parts were assembled, they fitted snugly into the reamed hole. The nest plate *C* was assembled in place and held down by means of two clamps. Then the washer was placed on the stud and the nut tightened. The tapered portion of the stud caused the split bushing to expand against the sides of the reamed hole with tremendous force, which was sufficient to amply withstand the stripping action against the nest plates.

New York City JOHN A. HONEGGER

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Decorative and Protective Coating for Aluminum

E. L. M.—Can you tell us whether the electrolytic process of applying a protective and decorative coating to aluminum and its alloys has any effect on the strength of the material so treated? Also, is the process adapted for use on both castings and sheet material?

A.—According to an article in November, 1932, MACHINERY, page 217, the Alumilite process, which we believe is the one you have in mind, is applied at temperatures not exceeding 200 degrees F., and therefore will cause no change in the material. This process is equally applicable to articles made from sheet aluminum, sand castings, die-castings, drop-forgings, and castings made in permanent molds. Either a plain finish or any one of a large range of highly lustrous colors, such as black, green, red, blue, bronze, etc., in both matte and polished finishes can be obtained by using this process.

Manufacturer's Responsibility for Guarantee Given by Dealer

A. B. D.—Is a manufacturer of machinery liable on a guarantee which he gives to a dealer, when the dealer sells the machinery to a user? In this case, can the user sue and recover from the manufacturer, instead of suing the dealer who gives his own personal guarantee to the user?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

Quite recently, this question was decided by a higher Court. In this case [Malooly v. Corporation, 258 N.W. 622], it was shown that a manufacturer of machines gave a guarantee to a dealer in part as follows: "We guarantee these units to be free from all mechanical defects in workmanship, material, and design."

When the user to whom the dealer sold the machine became dissatisfied with the machine, the user sued the manufacturer for damages. During the trial it was proved that the manufacturer had sent his representative to install the machine. Particularly in view of the fact that the manufacturer had installed the machine, and knew what the purchaser required, the higher Court held the manufacturer liable for $32,024, and said: "The manufacturer knew what plaintiffs (purchaser) needed and undertook to supply their needs. It is not merely a case of implied warranty, but it is one of special warranty . . . ."

However, if the manufacturer does not give a guarantee to the user, does not agree to supply a machine to suit the purchaser's requirements, and does not install the machine, then the user must sue the dealer and cannot recover from the manufacturer.

Lubricating a Vacuum Pump

W. C. P.—We have a vacuum pump installation where, due to the close hook-up of the pump to the condenser and the small size of the condenser, there is a small water carry-over into the pump about every twenty minutes. There is not enough water to cause any pounding and no danger to the pump. However, with the water getting into the pump, might it not be advisable to use a heavy grade of oil? We are now using a light air-compressor cylinder oil.

Answered by the Editor of "Oil-Ways,"
Published by the Standard Oil Co. of New Jersey

While there is hardly sufficient data on the installation to make a definite recommendation, it seems that the most suitable method of eliminating water carry-over to the vacuum pump is to provide a suitable water trap in the line between the condenser and pump. However, if this is not feasible, a change in the type of lubricant is desirable.

When moisture is a factor in vacuum pump lubrication, it is usually advisable to employ a lubricant compounded with a slight amount of "fixed" oil. The resultant product adheres to the cylinder walls and resists being washed off by the water, whereas a straight mineral oil, regardless of viscosity, tends to be removed from the cylinder walls by the water. Thus, in the latter case, scoring of the cylinder walls often results.

An oil containing a slight amount of "compounding," is excellent for air-compressor or vacuum-pump lubrication where moisture is present. This product forms an emulsion with the water in the cylinder, and the resultant oily film provides satisfactory lubrication for the cylinder walls.

Do Employe Suggestion Systems Produce Results?

The Author of this Article, Basing His Opinion on Many Years of Experience with a Successful Suggestion System, Says Emphatically "Yes"

By C. B. AUEL, Manager, Employes' Service Department
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

IN times such as these, when every concern has been using a fine-tooth comb to eliminate waste and to improve methods, common sense would seem to indicate that the entire working force should be asked to make contributions for the good of the concern. It is a fact, however, that in the great majority of plants no attempt has been made to do this, apparently on the assumption that the rank and file would have nothing to contribute.

Yet, when supervisory positions are to be filled in the plant, the shop force is examined for suitable individuals, and from that time on, those who are selected are expected to develop, among other things, a quota of worthwhile ideas. It is obvious that many of these ideas must have lain dormant previous to such appointments. Why were they not made available?

Suggestion systems offer the only practical medium of communication for the flow of ideas between workers and management, and these systems should, therefore, be studied by every concern to see whether or not they can be advantageously adopted. The fact that concerns known the world over for outstanding efficiency have had suggestion systems in effect for years, even continuing them throughout the depression, is the best recommendation these systems could have.

The author, therefore, suggests that any concern not having already familiarized itself with suggestion systems communicate with concerns that have had experience with them and learn of the details, including their limitations and possibilities. Full information will be gladly supplied by the writer.

Although all large waste has seemingly either been eliminated or recognized as unavoidable, an occasional important wasteful practice will sometimes be turned up through a suggestion system, and a method proposed for its abolishment. It is, however, rather through an accumulation of the smaller savings that a suggestion system will prove to be the most productive, as these, in the long run, will not only amount to

SUGGESTION BLANK
FORM 3065K

Westinghouse Electric & Manufacturing Company

With a view to improving, wherever possible, its apparatus and the conditions under which it is manufactured, and of effecting a net saving of time, money, labor or material, the Westinghouse Electric & Manufacturing Company invites practical suggestions and criticisms from all employes throughout the Works and Offices, and will award prizes, varying in amount, for original suggestions which are accepted. Heads of departments, superintendents and members of the Engineering Department under patent agreement are not eligible for prizes, and foremen, inspectors, demonstrators, engineers, draftsmen, rate and production men only for suggestions as to matters outside of their own lines of work.

Suggestions should be sent to the Suggestion Committee through the shop or office mail. Their receipt will be promptly acknowledged. If the regular suggestion blanks, Form 3065, are not available any kind of paper may be used.

All suggestions will be passed upon, whenever possible, within thirty days, by the Suggestion Committee, and those submitting them will be notified as to the action taken.

No suggestion is of too small importance to submit for consideration.

It must be appreciated that in some cases suggestions which are original with the sender will have been previously considered, or thought of by someone else, and the statement of the Suggestion Committee that any suggestion is not a new one must be accepted in good faith, even if the suggestion has not been used at that time and is put into effect later.

Regular awards will vary in amount from $2.50 and upwards, depending upon the value of the suggestions to the Company.

An award of $5.00 in addition to the regular awards will be paid, upon the acceptance of five suggestions from any one employe, $10.00 for ten suggestions, $15.00 for fifteen suggestions, etc., until fifty suggestions have been accepted and paid for. In other words the additional awards will be given for numbers of suggestions up to a limit of fifty when numbers or the series will start over again. As an aid to the Suggestion Committee, employes are requested to make claim for additional awards as they become due.

Following is a partial list of subjects on which suggestions are desired, though any one is at liberty to submit ideas on any other subject.

IMPROVEMENTS IN

Apparatus	Factory and Office Conditions	Miscellaneous
Quality	Health	Machines
Cost	Cleanliness	Tools
Quantity	Sanitation	Operations
Simplicity or Reliability	Ventilation	Jigs and Fixtures
Packing or Shipping	Order	Templates
Handling	Prevention of Fire	Transportation of Material
Finish	Prevention of Accident	Handling of Material
Design	Lighting	Storage of Supplies
Workmanship	Power	System and Methods
Material	Economy	

Leads to new business are particularly desirable. Suggestions on Waste Elimination are always in order.

Fig. 1. One Side of the Suggestion Blank, Giving Information about the System. The Other Side of the Blank Gives a Few Instructions for Making Suggestions, the Remainder being Left Blank for Writing in the Suggestion

a greater total saving, but, in addition, will be a constant advertisement of the system itself, if the names of the winners are published from time to time.

Lest too much be expected of a suggestion system, however, let it be said that, as a rule, an average of not more than 25 to 30 per cent of all suggestions received will prove to be of value; but, even at that, a system will more than pay for itself. Some of the ideas received could hardly be obtained in any other way, as, for example, those pertaining to alterations in jigs or fixtures to suit modifications in products. It will often be found that workers who have steadily done a certain kind of work can recommend alterations in jigs and fixtures long since set aside because of the replacement of the original product by a modified design, so that such jigs and fixtures can be brought into use again at a considerable saving.

Fig. 2. A Bulletin Showing Avoidable Waste in the Plant, Compared with the Value of Car Loads of Coal

Suggestions Need Not All be Along Mechanical Lines

As further tending to bear out the statement that ideas hardly available in any other way will be forthcoming, an innovation in connection with their suggestion system has recently been introduced by the Westinghouse organization in that employes have been invited to send in slogans or bulletins having to do with suggestions for safety, or the suggestion system itself and these, when accepted, or even modified before accepting, are treated the same as any other suggestions and awards made for them.

Two such suggestions are reproduced here:

Play Ball

In life, as in baseball, it is the number of times you reach home safely that counts.

SAFETY COMMITTEE

Contributed by an employe
of the Davenport, Iowa, office.

Keep Up The Good Work

Any suggestion of yours which is accepted not only helps you but helps the Company, and so helps all of us.

SUGGESTION COMMITTEE

This bulletin was prepared from ideas contributed by two employes of our Newark Works.

It will be noted that credit is given in each case to the works from which the bulletins emanate. Admitting that these slogans could be prepared by anyone properly equipped, it is a marked advantage in having such slogans or bulletins come from the workers themselves in that it is possible to get closer to the actual language used by them.

In starting a system, a suitable introductory letter should be prepared by the management, and the entire force, as nearly as possible, be permitted to participate. In addition to the introductory letter, printed suggestion blanks may be used, one side of which should contain a few simple rules and necessary information, while on the other side may be written the suggestion itself. The suggestion blank used by the Westinghouse company is reproduced in Fig. 1.

Suggestion boxes are not required if there is a shop mail service, as this may be used instead, although if the plant is a small one, it may be desirable to have suggestion boards on which bulletins advertising the system may be displayed at one or two points; here, also, blanks can be obtained and suggestions deposited.

A suggestion system, to be successful, needs the whole-hearted support of the management, as well as of the supervisory force. Without such support, it is a waste of time to install one.

It is Important to Obtain the Cooperation of the Foremen

The supervisory force, the foremen particularly, should be impressed with the fact that it is no reflection on their ability to have suggestions made by the shop employes. They should be told that it is a matter of cooperative effort, the foremen aiding the men by encouraging them to make suggestions, and the men, by making acceptable suggestions, helping the foremen. It is simply another application of the old saying that "two heads are better than one."

The Westinghouse Electric & Mfg. Co., after a study of suggestion systems both at home and abroad, installed one at their East Pittsburgh works in 1911, where it has continued uninter-

ruptedly ever since; similar systems have gradually been introduced in most of the other Westinghouse works. As carried out at the East Pittsburgh works, the system is of the simplest type, a minimum of labor and records being required.

How the Suggestion System is Operated

The system functions through a committee of five members, the chairman and the secretary both being permanent. The remaining three members are appointed by the management for yearly periods—two of them from the supervisory force and one from the "hourly" force.

Suggestion boxes were originally installed at suitable places throughout the works, with pads of suggestion blanks near by; but as it was found that so many boxes were required and there seemed to be no advantage in using them in preference to the shop mail, they were done away with. Furthermore, while the suggestion blanks are still continued, everyone is now so well acquainted with the working of the system that suggestions are largely submitted on ordinary paper.

As soon as received, the suggestions are numbered serially, and classified according to type or product. Then they are filed in numerical order. Acknowledgment is made to each employe on a special form. With this method of filing, any suggestion can be easily located if desired.

Fig. 3. A Bulletin Showing the Cost of Broken Tools and Careless Work

No attempt is made by the committee to pass upon the acceptability of suggestions (except as to bulletins or slogans). Three copies of each suggestion are made, two of which are forwarded to the head of the department most familiar with the subject, and one kept on file in the numerical order file.

Replies are made in triplicate to the committee by the department to whom the suggestion is submitted; and if a suggestion is not accepted, one copy of the reply is forwarded to the employe and the remaining copies filed. If the suggestion is accepted, the employe is also notified to that effect. One copy is retained for possible reference should the committee or the employe be dissatisfied either with the non-acceptance of the suggestion or with the award; in such a case, the matter is again given careful consideration by all those who are concerned with it.

Meetings of the suggestion committee are held monthly (or oftener, if necessary) when all suggestions recommended by the various departments for acceptance are considered in order to determine the amount of the award that should be made. When savings can be estimated, awards are usually based upon 10 per cent of the first year's savings. It is not possible, however, with a great majority of the suggestions, to estimate the savings, so a table of awards has been prepared as follows:

$2.50—Suggestions that are not original and that do not have appreciable money value, but that should be adopted, perhaps after modification, even though an expense may be involved.

$5.00—Suggestions that, although not original, have appreciable money value difficult to estimate.

$10.00—Suggestions that, although not original, have considerable money value estimated on an annual basis. Also suggestions that are original but have no appreciable money value.

$15.00—Suggestions that are original and have considerable money value estimated on an annual basis.

Above $15.00—Special.

In order to maintain interest, the scheme of offering an extra award has been developed for each set of five adopted suggestions, additional to the award made for each individual suggestion adopted—that is, $5 is paid as an extra award for the first five suggestions adopted; $10 for the second five; $15 for the third five; and so on until the limit of fifty suggestions has been reached, when the series recommences. It may be mentioned that a number of employes are on their second and third series. As to the amounts paid for suggestions, these have averaged approximately $5.86 each, with a maximum of $500.

Examples of Important Suggestions

It is practically impossible to set forth the advantages of some of the more outstanding suggestions, as they are almost invariably quite special to the industry; however, an attempt will be made to show what is actually suggested, over and above the general run of less important ideas.

1. Shipment of transformer oil to customers in larger containers than previously employed. This involved the shipment of oil more frequently in 50-gallon drums, giving customers at times a few more gallons than actually required (but at less

cost to us) rather than shipment of exact gallonage in smaller containers (at greater cost to us). A net saving of about $3000 annually has been effected, for which an award of $300 was made.

2. Belt glue. This glue has now largely served its purpose, owing to the general replacement of belt drive by individual motors; but when the suggestion was made, it was felt to be sufficiently valuable to warrant an award of $500.

3. The building up of thin iron sheets into stators and rotors by slipping them on the holding bolts from the side instead of from the top. The value of this suggestion will hardly be clear to the average person outside of the electrical industry, but it reduced the time of assembly on certain classes of work to about one-tenth of the former time, with a net saving of approximately $2500 annually, for which an award of $250 was made.

Preventing Waste in Industry

Several years ago an annual "Elimination of Waste Campaign" was sponsored by the American Society of Mechanical Engineers. This campaign is carried on continuously by the Westinghouse and other companies. The general plan is to make an appeal for the cooperation of the workers by the aid of bulletins, and further to show them the importance of little suspected wastes of many kinds by means of display boards. (See Figs. 2 and 3.) The suggestion system is the best practical medium of communication in such a campaign.

To show what has actually been accomplished by these campaigns, using a suggestion system as a medium, it will be sufficient to quote statements from two large organizations which are typical of many others:

Oakland Motor Car Co. (Division of General Motors Corporation): "From suggestions that lent themselves to our immediate uses, the savings represented amounted to $542,000, covering nearly a yearly period of operation.* From those that were held for later application, a like value was estimated as their actual worth, assuring us of a net profit on the expense and effort involved in the campaign of $1,000,000."

The United States Steel Corporation's report states that throughout the subsidiary plants suggestions were received by the thousands. The following items were mentioned:

Cutting down the thickness of hot saws used for a certain operation by 1/16 inch, whereby the amount of saw chips was reduced 2000 tons annually.

Placing platforms between two blowing engines, allowing one man to run both engines. Estimated saving $5000 per year.

Reduction of labor required for taking and preparing samples of ore. Estimated savings $3500 per year for one plant only.

Certain changes in limestone rescreening plant, which made a return of $8250 yearly.

The report adds: "It would be next to impossible to measure in money the savings that will result from the acceptance and operation of the suggestions that give promise of saving money; but this saving, great as it might be, will very likely be less than the intangible benefits resulting from the increased interest, efficiency, carefulness, and loyalty which the campaign introduced."

* * *

Engineering Work Should be Done by Engineers

In his address before the annual meeting of the Society of Automotive Engineers in Detroit, Frank M. Zeder, vice-president in charge of engineering of the Chrysler Corporation, emphasized the need for clearer thinking and better brains in public affairs. "Of all machines," he said, "the political machine is surely the most poorly designed, as far as its working for the public welfare is concerned. Engineers could redesign that machine with fewer parts, and, incidentally, might be able to find work for politicians who are now merely parasites on the government payroll. No wonder that there is too much overhead."

A few other quotations from Mr. Zeder's address are as follows: "Prosperity is the result of production, and not of the destruction of crops. It comes from the birth of new ideas, and not from birth control of pigs."

"To direct public works is an engineer's problem and not that of a politician. The alphabet projects need modern equipment and engineers to plan the projects."

"There is nothing fundamentally wrong with industry; and if the politicians would clean their own house and leave us alone, we would produce results."

"Government long established should not be changed for lightly considered and transient causes. Our government was founded to promote life, liberty, and the pursuit of happiness, and to this end, we engineers, more than any other class of society, are dedicating our life work."

* * *

The Engineer's Place in the Social Order

A characteristic of the engineer is his willingness to face the cold truth about the task to which he addresses himself. Engineers have brought to their jobs a more fully developed intellect than any other class of our citizenry. Sloppy, opportunistic thinking is simply inexcusable in the engineering world. I am asking that the same qualities be brought to bear in so far as possible on the more complex situations which have to do with living organisms and our social life.—*Henry A. Wallace, Secretary of Agriculture in "Mechanical Engineering."*

The Purpose and Duty of Industry

In a Recent Ford Sunday Evening Radio Hour, W. J. Cameron Spoke on "What Is Industry?" His Address was One of the Most Concise and Informative Answers to this Question. It is, Therefore, Reprinted Here in Full

"INDUSTRY does not support people; people support industry." Many read that motto in the rotunda of the Ford Exhibit at the Century of Progress. Today it has a new significance because government officials are demanding that industry employ at once the 11,000,000 persons that Washington says are unemployed, or take the consequences. If this demand is based on truth, certainly the motto is not; both cannot be correct.

The general impression is that this nation earns its living in industry. The facts make quite a different picture. Of all the people who work for pay in this country, ten million are attached to agriculture. Another ten million are employed in public and personal service—teachers, lawyers, doctors, nurses, public officials, entertainers, cooks, waiters, hired housekeepers, and so forth. Wholesale and retail trade engages between eight and ten million more—among them two million sales clerks and four million in other clerical positions. Four million people earn their living in transportation and communication, and another four million in the construction of buildings, streets, and highways. A million and a half engage in forestry, fishing, and mining.

These lines of business *are not classified by the government as industry,* although with other smaller groups they account for about forty million of our normal forty-eight million jobs. And no official has suggested that these employ the alleged eleven million unemployed. That is left for Industry proper, which at its highest peak, in its busiest time, never employed (in round numbers) more than 8,800,000 persons—the highest industrial employment in our history.

These figures for industry are given in Table No. 737 of the Statistical Abstract of the United States published in 1934 under the authority of the Secretary of Commerce. In this report, industry is comprised under the sixteen main branches of production which supply the nation's basic commodity requirements, ranging from food and wood and textile products to the iron, steel, and transportation equipment industries, including the automobile. Having at no time employed as many as 9,000,000 persons, these sixteen branches are asked to employ immediately an additional 11,000,000 persons, "or else—"

Two things are clear: First, that any group which normally employs less than nine million persons, of whom probably seven million are now at work, cannot possibly be said to have eleven million of its people out of work. *It never had that many people.* And second, any group whose highest peak of business was never sufficient to employ more than nine million persons cannot, even at government command, arbitrarily increase that number to 20,000,000. *There never has been that much purely industrial work to be done.*

This misconception of the comparative place of industry in the national fabric has lasted a long time—like the mischievous statement that the rich two per cent of the people own between 80 and 95 per cent of the wealth, when as a matter of fact 72 per cent of the *wealth* and 88 per cent of the *income* are owned by people who have *less* than $5000 a year. It is true that industry is important and that it affects all other lines of work, just as all other lines of work affect it, but four-fifths of American workers always have been employed at something else. The nation could hardly exist otherwise.

The Purpose of Industry is to Produce

Industry earns *its* living by making the tools and utensils which the rest of the people use in earning *their* living—shovels for diggers; plows and trucks and cream separators for farmers; ovens for bakers; hammers and saws and nails and lumber for carpenters; leather for shoemakers; motor cars and electric cars and railway cars and locomotives for transportation; machines for all sorts of mechanical work; cloth and sewing machines for clothiers; paper and ink and presses for printers, and so on. Industry has never supported all the workers and never can—it can only equip workers with the things they use to support themselves in the infinitely diversified forms of daily work.

Industry alone has led in efforts to start the wheels of employment turning. In one year it has spent above its income more than the enormous emergency expenditures of the government itself. Its efforts have succeeded to a remarkable degree. Yet, Washington has complained that employment is not increasing as fast as production. Here is the same old error again—measuring the entire employment situation against one-sixth of the nation's work.

Industrial employment *has* kept pace with pro-

duction. If industry could give work to those 11,000,000 unemployed (if there are that many) it would have done so long ago in its own interest without being asked. But these are in very small part the workers of industry. They belong mostly to the other groups that perform five-sixths of the nation's work.

The matter is too serious to permit misleading statements to pass, and we submit these facts in the interest of straight thinking.

* * *

Manipulator for Tilting Heavy Work When Welding

A manipulator which permits positioning work to be welded so that fillet welds of correct radius can be made without wasting electrode metal is shown in Figs. 1 and 2. It is claimed that a saving of 25 to 40 per cent in welding time alone is obtained through the use of this manipulator, which was developed by the United Engineering & Foundry Co., Pittsburgh, Pa. The manipulator also eliminates the necessity for using overhead cranes during the welding operations, thus freeing the cranes for other work. This, in turn, makes it unnecessary to employ riggers. The welding manipulator can be moved to the place where the welding is to be done.

The manipulator consists of a faceplate turned by a Lincoln Electric "Link-Weld" motor, the latter operated by a push-button control with extension cord. By pressing the proper control buttons, the faceplate can be tilted or rotated to any desired position, the operator riding with the work. The capacity of the manipulator shown is from five to seven tons, depending on the position of the center of gravity of the work.

Weldability of Materials

In an article published in *Oxy-Acetylene Tips*, attention was called to the importance of selecting a good weldable material if the best results are to be obtained in constructing equipment and devices made with welded joints. Frequently, complaints are heard about the plant to the effect that the welders are not turning out a first-class job, when, as a matter of fact, the welders are quite capable of doing fine work. The trouble is that they cannot turn out a first-class job if the management does not provide them with a material that is weldable.

It is not a question of either cheap or expensive material—it is simply a matter of the right material. Some steels may be just as good as other steels for general purposes, and they may be just as expensive, but it may not be possible to weld them as easily as another steel. Obviously, the burden of giving the welders the kind of steel that is easily weldable falls on the management. It is suggested that manufacturers who utilize welded construction in their products add to their specifications, when ordering materials for welded fabrication, the words: "Of good welding quality."

* * *

S. T. Douglas, of the Colonial Beacon Oil Co., Boston, Mass., in an article published in *Oil-Ways*, mentions a case where a bearing was running hot because of too much lubricant. A reduction gear unit with roller bearings was running hot, throwing grease. The operator was using good grease and giving the bearings "all they would take." That was his trouble. He was packing the bearings too tightly. A lubricating engineer simply took out some of the grease and the heating stopped.

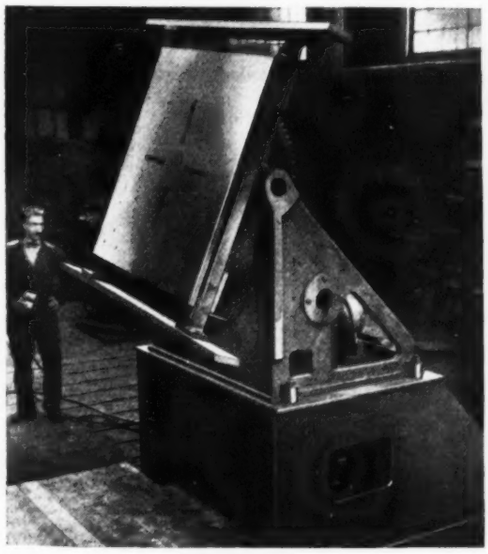


Fig. 1. Welding Manipulator Developed by the United Engineering & Foundry Co.

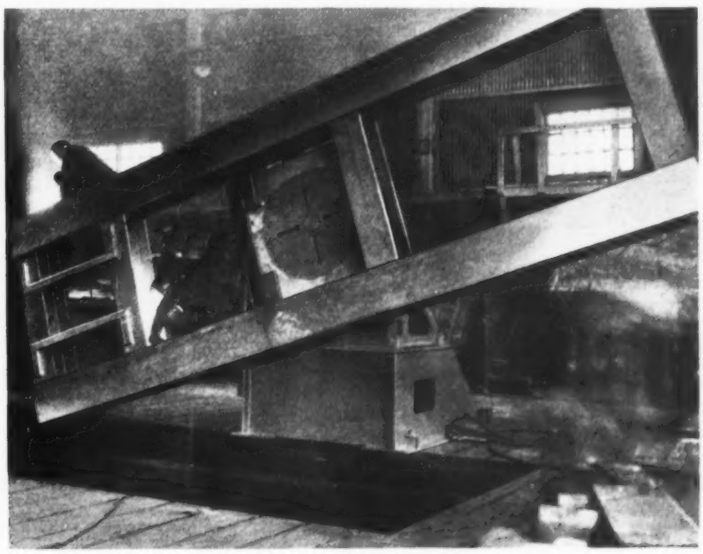


Fig. 2. The Operators Using this Manipulator can Tilt the Work to Any Angle Desired by Operating the Push-button Control

Oxy-Acetylene Welding and Cutting Progress

DURING the past year, the oxy-acetylene industry made considerable progress not only in the technique of methods and equipment, but also in obtaining recognition for its processes in fields where the requirements are exceptionally severe.

A year ago the National Board of Fire Underwriters issued tentative rules for the fusion welding of gravity tanks, tank risers, and towers. These rules make it permissible to fusion-weld any part of a sprinkler system except riser pipes inside of buildings. Recognition by this authority is a noteworthy step forward.

Of equal, if not greater, significance is the recognition of flame cutting in the revision proposed by the Boiler Code Committee of the American Society of Mechanical Engineers. These changes would permit the use of oxy-acetylene flame cutting for the preparation of plate edges in steel of up to 0.35 per cent carbon content for boiler and pressure vessel fabrication.

This action appears to be the logical conclusion of much research carried on during the last few years. Since boiler and pressure vessel fabrication is subject to perhaps the most rigid control of any type of manufacturing, acceptance of flame cutting in this field indicates its suitability for practically any type of plate edge preparation.

The improvements in the fabrication of chromium-iron alloy materials are also of importance. The air-hardened propensities of chromium steels can now be overcome, both in welding and cutting. By the use of columbium or titanium in small quantities, properly alloyed with chromium steels, it has been found possible to eliminate the air-hardening difficulties. The introduction of columbium-treated 18-8 stainless steel welding rod in conjunction with 18-8 base metals, treated or "stabilized" with columbium or titanium, makes it possible to fabricate stainless steel products which, in the "as welded" condition, have full resistance to corrosion and oxidizing influences, particularly at high temperatures.

Of considerable importance to the industry is a report presented at the annual convention of the International Acetylene Association last November concerning the actual use of oxy-acetylene welding for the fabrication of unfired pressure vessels and power boilers in the Class 1 A.S.M.E. classification. In this report, many advantages of the use of the oxy-acetylene flame for the fabrication of this type of products are brought out.

The field fabrication of the Boulder Dam penstocks is probably one of the most notable examples of gas cutting in recent years, because of the huge size of the work and the impossibility of fabricating these penstocks elsewhere and shipping them to the job. The shaping of the unevenly curved steel segments was done entirely by means of the oxy-acetylene portable cutting machine.

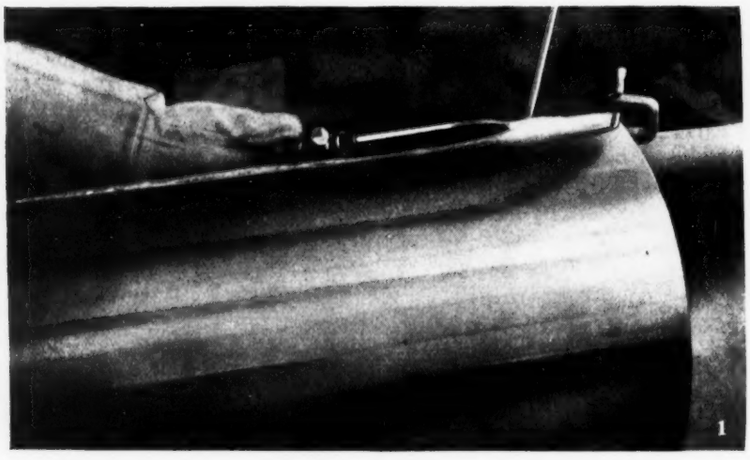
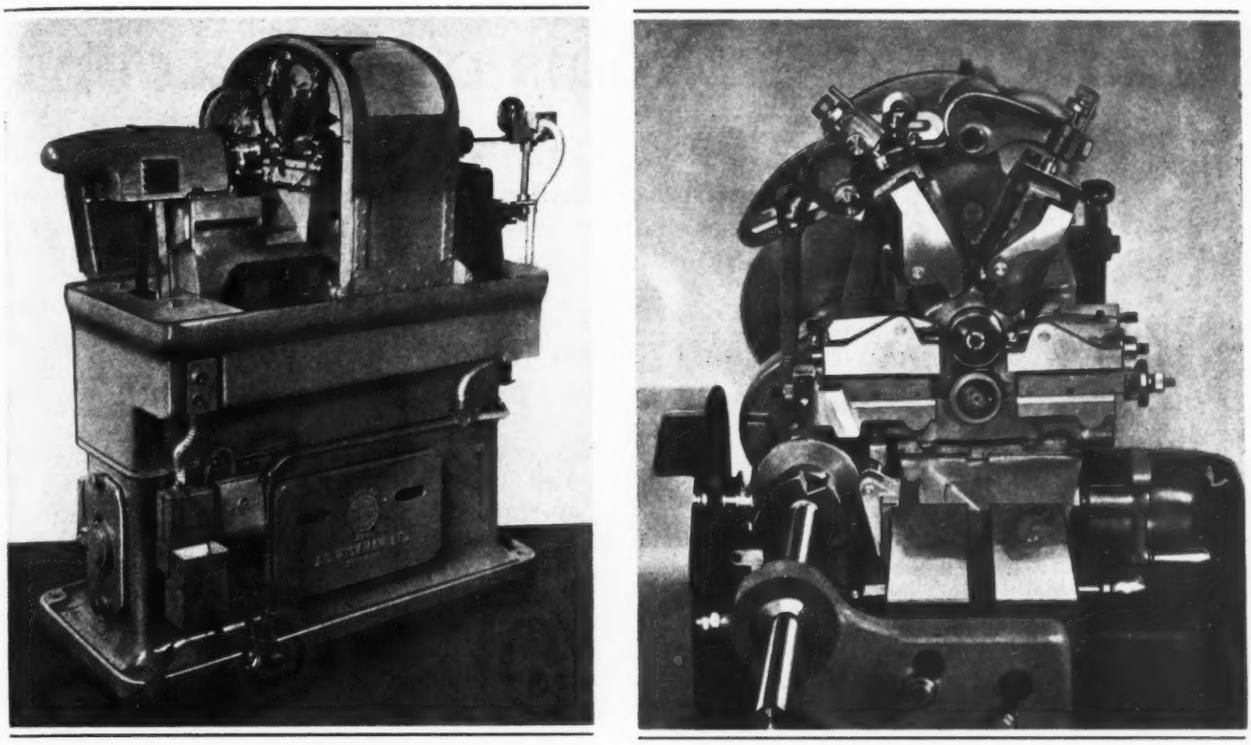


Fig. 1. The Successful Ox-welding of Stainless Steel Containers is Now Possible by Means of Columbium-treated Welding Rod and Steel. Fig. 2. Progress in Shape Cutting with the Oxy-acetylene Flame. These Gears, Cut from Steel Plate, are Used Practically without Finishing in the Machines for which They are Fabricated—Photographs Courtesy Linde Air Products Co.



(Left) Front View of Machine Complete with Guards and Equipped with Threading and Slotting Attachments. (Right) Close-up View of Tool-slides and "Platform" for Locating Attachments

These penstocks range from 13 to 30 feet in diameter, and are made from material varying from 5/8 inch to 4 1/2 inches in thickness. It is obvious that this presented a most difficult cutting problem, especially since all of the plates were curved in two directions. Nevertheless, it was possible to fabricate and prepare the edges without the need for subsequent machining or other preparation.

It is also possible to record as an achievement of the past year a more definite fundamental knowledge relating to the metallurgy of oxy-acetylene cutting and welding. A marked emphasis has been placed on the importance of the redesigning of products for welded fabrication. All of these trends point definitely toward the increasing importance of the oxy-acetylene process in industry.

* * *

A British High-Speed Precision Automatic

The accompanying illustrations show an automatic turning machine having features somewhat different from the more generally known designs of this type of machine. It is known as the Wickman 10-millimeter automatic, and is made by Bryant Symons & Co., of London, for A. C. Wickman, Ltd., Coventry, England.

The machine is intended for a large variety of comparatively small work, such as pinions for clocks and meters, screws, and all parts for radio and other small electrical equipment. It is provided with sufficient power to use the new high-speed cutting alloys to their full capacity. In designing the machine, particular attention was paid to the simplicity and ease of camming and tooling. The machine normally has three spindle speeds, but this number can be increased as desired. For each of these spindle speeds there are 117 feed changes.

It will be noted that the machine has four tool-slides, each having a quick clamping device. Micrometer adjustments are provided for setting the tools both in a cross-feed direction with relation to the work, and in a sidewise direction in relation to the spindle nose.

To avoid damage to the machine, a shear pin is incorporated in the camshaft mechanism, together with a limit switch which breaks the circuit. When the bar stock in the machine is used up, the machine automatically stops. Modern lubrication is provided by using the "one shot" system and by having the spiral gears and worm used for the feeding mechanism run in an oil bath.

* * *

A total of 4,150,000 cars and trucks was produced in the United States and Canada in 1935, according to the Automobile Manufacturers Association. This output surpasses all years since 1929 and exceeds last year by 45 per cent. The total registration of cars and trucks at the end of 1935 was approximately 26,000,000 vehicles.

Radium as a Means of Inspection

Radium Inspection for Detecting Flaws in Heavy Forgings and Castings has Recently Gained Ground. The Present Article Outlines Some of the Applications

By J. F. SPRINGER

THE mysterious element radium has entered industry as a means for inspecting the interior of metal parts without destruction. The United States Navy is using it in important work and the United States Army is specifying its employment in connection with equipment for a lock on the Mississippi River. The Treadwell Construction Co. is also understood to have made industrial use of this means of inspection.

This use of radium has a great deal of interest for the engineer. Up to a short time ago this element seemed to belong to the doctors and hospitals, but now it appears that the use of radium for industrial inspection purposes may bring about a kind of cooperation between the doctor and the metallurgical engineer. Because of the expense of radium, the hospital and foundry may become joint users of the same radium, in their respective fields.

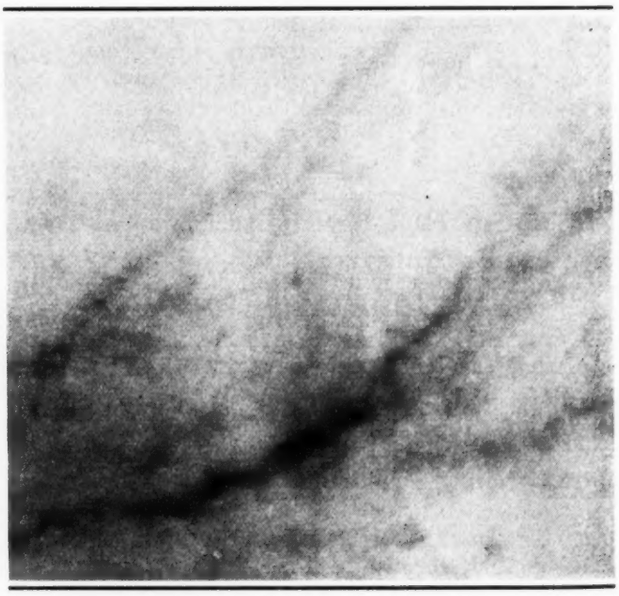
Radium sends forth rays different from, yet in some respects similar to, X-rays. It is, therefore, possible by its use to examine the interior of metal objects without cutting or destroying them. A photographic film of the same kind as is used for X-ray radiographs is placed back of the metal to be radiographed. The gamma rays emitted by radium pass through the metal and record on the film any cracks, blow-holes or other defects. To interpret these films is no job for a novice, but a technique has been developed, both for carrying on the inspection work and for the interpretation of the films, that gives practical results.

The industrial application of radium for non-destructive inspection of metals is about five years old. There are at least two radium concerns who are in a position to supply radium or the gas which emanates from it, and radium and radium gas are now available for industrial use on a rental or a purchase basis.

Radium is not available in Nature by itself nor is it used in its pure state or in an approximately

Steam Trap for a Radiator Photographed by Gamma Rays. Note the Clarity with which Interior Details May be Seen

A Gamma Ray Radiograph of a Steel Casting which is from 5 to 6 Inches Thick. The Picture Shows Quite Clearly Shrinkage Cracks in the Interior



pure state. It may be sulphate of radium, for example, that is actually handled when we speak of radium. Like electricity, radium is mysterious as to its exact nature, but we are learning how to use it for practical purposes as we have learned to use electricity. Radium and electricity are also alike in that both may be dangerous. How to avoid the dangers of radium is now pretty well understood. What the hospitals have learned has made it easier for the metallurgist to develop safety measures.

The gamma rays emitted by the radium salt go forth at all times in all directions. The rays emitted reduce the volume of the radium itself, but so slowly that it takes something like 1500 years to exhaust its power. Hence, while a gram of radium costs $55,000, it may be considered as a non-deteriorating asset, because of its exceedingly long life.

Radium also gives off a gas known as "emanation." This gas emanation also emits gamma rays, but not indefinitely; its "strength" is used up in about 3 1/2 days. However, the gas emanation can be used for hospital service instead of element radium, and it is quite customary to do so. The metal inspector can also make use of the gas, but he must remember that it will retain its power only for a few days, and that its strength is diminishing meanwhile. The gas should be used immediately for best results.

As mentioned, the gamma rays go forth in all directions and at all times. This characteristic may be made use of when obtaining inspection negatives. It is possible to use the entire surface of an imaginary sphere and place a number of objects all around the radium source. If all the objects require the same penetrating power of the gamma rays, they may be placed at the same distance from the source and all may be radiographed at the same time. If the objects require different intensities of exposure, they may be placed at different distances from the radium source. Again, if a circular object is to be inspected—for example, a circumferential weld in a boiler shell—it will be possible to obtain all the films wanted with one exposure. As an example may be mentioned some work done by the Bell Telephone Laboratories in New York City. The laboratories rented a source of gamma rays at a cost of $25. They assembled a number of objects for radiographing and obtained a number of radium films at once.

One of the specific advantages in using gamma rays for inspection such as mentioned is that they can be used for very great thicknesses of metal. Radium rays are said to have penetrated objects 8, 9, and even 10 inches thick. Take for example, the stern post casting for a Navy cruiser; the thickness may run up to 7 inches. Such a casting can easily be inspected with the radium gamma rays, and they have, in fact, been so used. Such inspection not only prevents the danger from the use of a defective casting, but also may save machining costs. While the defects may come to light after machining, so that the dangerous casting might not be used, the work put upon it would be wasted; nor is it always possible to determine while machining whether a small flaw that may show on the surface extends sufficiently far into the interior to be of any account.

Inspection methods that permit one to look into the interior of the casting obviously will dispel doubts of this kind. Both X-rays and radium gamma rays are available for this type of inspection. It is likely that there is a distinct field for both of these inspection methods. At present it would seem that the gamma rays have an advantage when very thick metals are to be penetrated.

Another advantage claimed for the gamma rays is the ease with which the source can be managed. The rays may be derived from a little glass bulb or a small capsule, which can be conveniently placed wherever necessary for obtaining the required radiograph. The Director of Radiological Research at Woolwich, England, V. E. Pullin, apparently a friend of both X-rays and gamma rays, has called attention to the usefulness of both, according to the circumstances, and pointed out that radium can be used advantageously whenever, owing to inaccessibility, it may be difficult to use X-ray equipment.

At any rate, a new means for non-destructive inspection is available, and further research will doubtless make it apparent to what extent it is superior to other methods, and where it must yield to other methods that, for certain conditions, will be more advantageous.

* * *

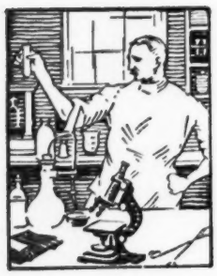
A Noise-Indicating Meter

In order to record by visual means the noise created by different kinds of gears, the Synthane Corporation, Oaks, Pa., manufacturer of laminated Bakelite sheets, rods, tubes, and gear materials, has developed a device known as the "Noisometer." In this device, different types of gears can be thrown into mesh and the noise recorded. For example, through a gear shift lever, either a Synthane gear or a steel gear can be thrown into mesh with other steel gears. Thus a comparison of the noise produced in using a synthetic plastic material and in using steel can easily be made. Since the shifting of the gears can be made while running, it is possible to make a comparison of the noise by ear. A more graphic comparison, however, can be made by the eye at the same time, since the noise generated by the gears is recorded by a cathode ray oscillograph. The height of the wave, or amplitude, represents the volume of the noise.

* * *

Inventive genius has devised new and strange forms of taxes. We cannot devote our lives merely to producing revenue for a government. Government should certainly not be the chief end of all human effort.—*Henry Ford*

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

"Hi-Steel"—A Recent Low Alloy of High Tensile Strength

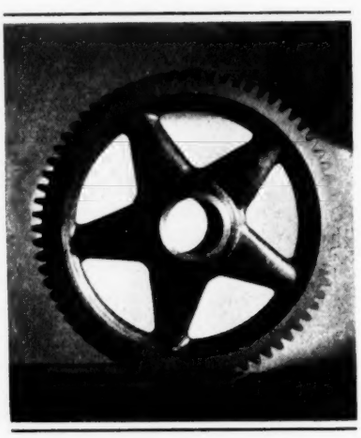
A new steel of the so-called "low-alloy, high-tensile-strength" class has been placed on the market by the Inland Steel Co., First National Bank Bldg., Chicago, Ill., under the trade name of "Hi-Steel." The minimum yield point of this steel is 60,000 pounds per square inch for sheets of lighter gage than 1/4 inch, and 55,000 pounds per square inch for sheets of heavier gage. The tensile strength is 70,000 pounds per square inch.

This steel possesses a high degree of uniformity, and tests have shown that the material can be readily bent, formed, stamped, and welded. It is highly resistant to corrosion. "Hi-Steel" will be supplied in sheets, strips, plates, bars, and structural shapes.

Spoke Type Non-Metallic Gears for General Industrial Use

Spoke type gears made of Celoron were introduced to the automotive industry about two and a half years ago by the Continental-Diamond Fibre Co., Newark, Del., for use as timing gears. Because of their satisfactory operation, these gears have now been made available for general industrial use. Celoron is a laminated material, made by impregnating sheets of heavy fabric with resin and then subjecting the sheets to high heat and pressure. The result is a homogeneous sheet or blank that is tough, slightly resilient, and highly resistant to oil, water, heat, cold and chemicals.

The particular advantages claimed for spoke type gears of this material include unusually quiet operation, due to the lack of tendency of the gear to synchronize with critical speed harmonics or any other vibration that may be set up by a mechanism; high shock-absorbing qualities; and long life.



Celoron Spoke Type Gear, now Available for General Industrial Applications

Huge Cylinders of Alloy Steel Help Locomotive Climb Steep Grades

A high-powered locomotive with alloy-steel cylinders weighing 7000 pounds each is being built by the Great Northern Railroad for use on the steep grades of the Rocky Mountains. The alloy steel from which the cylinders are cast contains 2 per cent nickel, according to the *White Metal News Letter*, published by the International Nickel Co., 67 Wall St., New York City. The complete assembly of the two cylinders and saddle weighs approximately 17,000 pounds.

Seamless Tubes of Alloy Steel for Use at High Temperatures

Tubes and pipes made from an alloy steel that offers unusual resistance to oxidation and that is suitable for continuous use at temperatures as high as 2100 degrees F., have recently been made commercially available by the Babcock & Wilcox Tube Co., Beaver Falls, Pa. The alloy steel from which these tubes are made contains 25 per cent chromium and 20 per cent nickel. Its properties are such that tubes and pipe made from this steel will probably find extensive use in high-temperature cracking and other refinery operations, as well as in thermo-couple protection tubes, valves, and heat-resistant tubular members.

These seamless alloy-steel tubes are available hot-finished

in sizes up to 6 inches outside diameter, and cold-drawn in smaller sizes. They are being marketed under the trade name of B & W Crololy 25-20. This alloy has been obtainable heretofore in the form of sheets, plates, rods, and castings for high-temperature applications, but it has not been available in tube form, except after tedious forging and boring operations.

Chromium-Molybdenum Steel Used in Fabricating the "China Clipper"

Many engineers who have been following newspaper accounts of the spectacular achievements of the *China Clipper* will be surprised to learn that each of the 2380-pound engines (including the weight of an 800-horsepower engine and its accessories as well as the cowl and propeller) is supported by a tubular mounting that weighs only 74 pounds. Tubes of chromium-molybdenum steel (4130X), heat-treated to give a tensile strength of 95,000 pounds per square inch, make up this mounting, according to *The Moly Matrix*, which is published by the Climax Molybdenum Co., 500 Fifth Ave., New York City. The tubes are of 18 and 12 gage, and are welded together.

The same alloy is used for other pieces of the airplane wherever strength and light weight are a necessity. For instance, the bracket which supports various control wires, such as the aileron wires, is constructed of chromium-molybdenum steel. Some pieces are made of tubing, while others are fabricated from tubes, sheets, and bars welded together. Forgings of chromium-molybdenum steel are also used in many cases. For example, the hinge fittings on the wings are forgings which are machined to size and shape. Forged and sheet fittings are also used in the bulkheads to obtain a rigid hull structure.

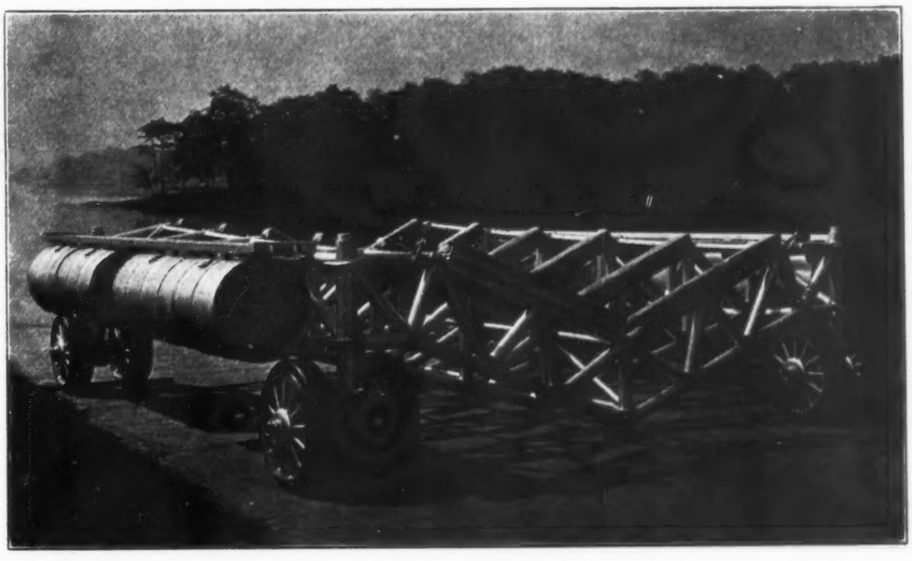
The *China Clipper* is carried in and out of the water, and also moved about on land, by means of the handling truck here illustrated. The trusses of this truck are also fabricated from 16-gage chromium-molybdenum tubing. This truck will carry a load of over 35,000 pounds.

Phenolic Molding Compounds with Graphite Added

When phenolic molding compounds are used for such applications as cam parts, automobile-door bumper shoes, building hardware, refrigerator latch bolts, and machine parts, they are generally subjected to both friction and impact shocks. To withstand friction in such uses to a greater extent than the standard phenolic compounds, General Plastics, Inc., North Tonawanda, N. Y., has developed Durez 1564, which contains 10 per cent graphite. This material is claimed to have an impact strength approximately 40 per cent greater than ordinary compounds.

New Alloy Cuts Weight of Railway Trucks and Increases Capacity

According to the International Nickel Co., a new alloy steel known by the trade name "Prescoloy," which was developed by the Pressed Steel Car Co., made possible the new cast nickel-steel railway trucks developed by that company, which weigh 13,000 pounds less than previous designs but carry 26,000 pounds more weight. It is estimated that this new truck will result in the saving of $220 per car per year. It is interesting to note that had the two million freight cars now in service on American roads been of this type, the savings based on the estimated performance would have been sufficient to pay off a $139,000,000 operating deficit one year and, in addition, make a surplus available for dividends.



The "China Clipper" is Carried into and out of the Water by an Eight-wheel Truck which is Fabricated from Chromium-molybdenum Steel Tubing

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

Diemakers' Supplies

DANLY MACHINE SPECIALTIES, INC., 2112 S. 52nd Ave., Chicago, Ill. Catalogue containing complete data on the line of diemakers' supplies made by this concern, including precision die sets; commercial die sets; large and special stamped steel die sets; all-steel torch-cut die sets; miscellaneous diemakers' supplies, such as pins, bushings, screws, springs, etc.; and welded steel machine parts. The catalogue is provided with a handy thumb-index.

Nickel Cast Irons

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Bulletin No. 6 in a series on Nickel Cast Iron Data, treating of the thermal expansion characteristics of some nickel cast irons. The bulletin contains the results of recent research that indicate that alloyed cast irons possess a range of expansivity suitable for use where thermal expansion is a factor. This bulletin should prove particularly useful to the designing engineer.

Abrasive Products

GARDNER MACHINE CO., 414 E. Gardner St., Beloit, Wis. Booklet covering the Gardner line of abrasive products, including abrasive wheels, disks, wheel-dressers, etc. The construction and advantages of the "Wire-Lokt" wheels (designed to insure safety in operation) are described, and information is given on the three types of G.I.A. disks available for many jobs where the heavier type of wheel is not required.

Bronze Products

JOHNSON BRONZE CO., New Castle, Pa. 1936 edition of the Johnson general catalogue of bronzes. This catalogue is published in three sections, the first of which gives complete size and weight information on Johnson "Universal" completely machined bronze bars; the second section lists over 600 sizes of general-purpose bronze bearings; and the third section deals with Johnson electric motor service bearings.

Stainless Steel

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Catalogue on Allegheny stainless steels, printed in colors, presenting a great number of illustrations of products made from stainless steels, which give a good idea of the wide field of application of these steels in all lines of industry. Designers should find much of suggestive value in this booklet.

Vibration-Absorbing Material

ARMSTRONG CORK PRODUCTS CO., Lancaster, Pa. Bulletin entitled "How to Lessen Vibration with Armstrong's Vibracork." The bulletin gives information on how Vibracork is made, suggestions on installation, and data on proper loadings for different densities. Correct methods of application for different conditions are described, and illustrated by diagrams.

Zinc Alloys

APEX SMELTING CO., 2554 Fillmore St., Chicago, Ill. "Metalgram" No. 3 containing diagrams showing the elongation of No. 2 zinc-base die-cast alloy cast at different metal temperatures and different pressures. "Metalgram" No. 4 showing the impact strength of No. 2 zinc-base die-cast alloy for different metal temperatures and pressures.

Lubricants

ALEMITE, DIVISION OF STEWART WARNER CORPORATION, 1878 Diversey Parkway, Chicago, Ill. Industrial Lubrication Reference Manual, containing a fund of information regarding the efficient lubrication maintenance of machinery. The Alemite line of industrial lubricants is also described.

Flexible Shaft Equipment

R. G. HASKINS CO., 4634 W. Fulton St., Chicago, Ill. General catalogue 44, covering the Haskins line of flexible shaft equipment. In addition to giving complete specifications for the machines, many applications of this type of equipment in various industries are illustrated and described.

Duplicating Attachments for Milling Machines

CLEARING MACHINE CORPORATION, 6499 W. 65th St., Chicago, Ill. Folder illustrating and describing the Clearing duplicating attachment for milling machines, the use of which makes it possible to greatly reduce the time and expense involved in duplicating dies.

Power Transmission Equipment

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Bulletin 2188 A, covering the company's recently extended line of Duro-Brace Texsteel sheaves for Texrope drives up to 15 horsepower. Tables of dimensions, horsepower, and center distance, as well as price lists, are included.

Synthetic Plastics

GENERAL PLASTICS, INC., North Tonawanda, N. Y., is distributing a monthly publication known as "The Durez Plastics News," which contains information on the general subject of plastics and on the many applications of molded Durez in product design.

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular entitled "Down Goes Battery Truck Maintenance Expense When You Use This New GE Control," containing facts about a new magnetic-contactor type controller for battery truck service.

End-Mill Sharpening Fixture

WELDON TOOL CO., 321 Frankfort Ave., Cleveland, Ohio. Folder illustrating and describing the Weldon end-mill sharpening fixture for reconditioning spiral end-mills without the use of centers or lead cams. Instructions for using are included.

Stainless Steels

CHEMICAL FOUNDATION, INC., 654 Madison Ave., New York City. Booklet entitled "The Stainless Prince of Steels," illustrating and describing many different applications of the various types of stainless steel in the industrial and architectural fields.

Electrically Heated Laboratory Apparatus

HAROLD E. TRENT CO., 618-640 N. 54th St., Philadelphia, Pa. Leaflet TD-23, containing data on electrically heated hot plates, crucible furnaces, tubular furnaces, and muffle type furnaces for laboratory use.

Gear-Grinding Machines

PRATT & WHITNEY CO., Hartford. Conn. Circular 420, descriptive of the Pratt & Whitney 10-inch hydraulic gear grinder for spur and helical gears. Complete specifications for the single-wheel and two-wheel machines are included.

Nickel-Clad Steel

LUKENS STEEL CO., Coatesville, Pa. Bulletin 18-AV, describing Lukens Nickel-Clad corrosion resisting steel. The properties and characteristics of this material are described, and six pages of tables of applications are included.

Pumps

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Catalogue W-102-B1 and W-312-B1A, describing Worthington horizontal duplex piston pumps for general services and single-stage volute centrifugal pumps, respectively.

Cleaning Compounds

DETROIT REX PRODUCTS CO., 13006 Hillview Ave., Detroit, Mich. Circular containing information on solvent degreasing by the vapor method. The circular also describes the Rex degreasing machines made by this company.

Electric Tachometers

ESTERLINE-ANGUS CO., Indianapolis, Ind. Bulletin 935, describing the features of design and the application of Esterline-Angus electrical tachometers for indicating the speed of machinery and industrial equipment.

Heat-Treating Equipment

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Leaflet outlining the advantages resulting from the use of the triple-control Hump hardening method, and its application in making silver-striking dies.

Gear Finishing Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, Mich. Circular illustrating and describing the Michigan gear finisher—its principle of operation and features of construction. Installation dimensions are included.

Hardened and Ground Die-Heads

LANDIS MACHINE CO., INC., Waynesboro, Pa. Folder illustrating three types of the Landis new series hardened and ground die-heads for use on hand and automatic threading machines.

Electric Hoists

NORTHERN ENGINEERING WORKS, 210 Chene St., Detroit, Mich. Bulletin EH-250, illustrating this company's latest development in overhead Monorail electric hoists for handling heavy loads in a minimum space.

Electric Tools

INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, Ill. Catalogue 60, showing the complete line of Thor high-frequency electric tools, including drills, screwdrivers, nut-setters, tappers, grinders, balancers, etc.

Compressors

INGERSOLL-RAND, 11 Broadway, New York City. Bulletin 3162, describing the Ingersoll-Rand line of power-driven, horizontal duplex, double-acting, heavy-duty compressors of motor-driven and belt-driven types.

Abrasion-Resisting Steel

CARNEGIE-ILLINOIS STEEL CORPORATION, Pittsburgh, Pa. Pamphlet on abrasion-resisting alloy steels, giving chemical analysis, physical characteristics, uses, information on machining, heat-treating, welding, etc.

Rust-Resisting Iron

REPUBLIC STEEL CORPORATION, Youngstown, Ohio. Folder 148, containing condensed information on rust-resisting Toncan copper-molybdenum iron, including physical properties and physical constants.

Electric Equipment

DELTA-STAR ELECTRIC CO., 2400 Block, Fulton St., Chicago, Ill. New price lists covering bus bar and conductor fittings, indoor bus supports ranging from 1500 to 23,000 volts, and insulator cable supports.

Multiple V-Belt Drives

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Circular L-400-B7, containing sizes and list prices of Worthington multiple V-belt drives equipped with Goodyear Emerald cord belts.

Heat-Treatment Accessories

STRUTHERS DUNN, INC., 139 N. Juniper St., Philadelphia, Pa. 28-page catalogue illustrating and describing relays, timing devices, thermostats, resistors, thermal links, insulators, pots, and ladles.

Ball and Roller Bearings

HOOVER STEEL BALL CO., Ann Arbor, Mich. Lubrication bulletin No. 6, containing a table of recommended greases for ball bearings of different sizes, operating at varying speeds and temperatures.

Portable Electric Tools

SKILSAW, INC., 3310 Elston Ave., Chicago, Ill. Catalogue 36, covering the complete line of portable electric tools made by this company. Among the tools described are five new models of Skilsaw drills.

Indicating and Recording Instruments

IDEAL COMMUTATOR DRESSER CO., 1213 Park Ave., Sycamore, Ill. Folder describing the Ideal "Tel-Temp," a new inexpensive type of industrial thermometer.

Optical Instruments

GAERTNER SCIENTIFIC CORPORATION, 1201 Wrightwood Ave., Chicago, Ill. Catalogue L-2, containing

data on the line of optical instruments made by this concern for laboratory use.

Recording and Controlling Instruments

BROWN INSTRUMENT CO., 4485 Wayne Ave., Philadelphia, Pa. Folder illustrating and briefly describing the features of Brown air-operated controllers.

Portable Grinders

DUMORE CO., Racine, Wis. Booklet entitled "1/10,000 of an Inch," containing a treatise on precision tolerances and briefly describing several precision grinders made by this concern.

Blast Cleaning Equipment

PANGBORN CORPORATION, Hagerstown, Md. Circular entitled "That's New Business Knocking at Industry's Door," treating of the Pangborn blast cleaning and dust collecting equipment.

Asbestos Friction Materials

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J. Catalogue describing this company's complete line of Condor industrial friction materials.

Cold-Drawn Steel

UNION DRAWN STEEL CO., Massillon, Ohio. Circular entitled "Is There a Better Way to Make It?" describing several successful applications of Union cold-drawn steel.

Steam Turbines

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GEA-1145C, descriptive of GE steam turbines for the mechanical drive of pumps, fans, compressors, blowers, etc.

Electroplating Equipment

GRASSELLI CHEMICAL CO., INC., 629 Euclid Ave., Cleveland, Ohio. Bulletin on metal finishing, describing the electroplating equipment and chemicals made by this company.

Electric Motors

RELIANCE ELECTRIC & ENGINEERING CO., Ivanhoe Road, Cleveland, Ohio. Bulletins 120 and 121, describing Reliance fully enclosed fan-cooled ball-bearing induction motors.

Hydraulic Lathes

PORTER-CABLE MACHINE CO., Syracuse, N. Y. Circular illustrating and describing the Carbo-Hydraulic lathe, a full-automatic "cycle" lathe for production work.

Knife and Saw Grinding Machinery

SAMUEL C. ROGERS & CO., 191 Dutton Ave., Buffalo, N. Y. Illustrated price list of Rogers saw and knife grinding machinery.

Electric Timers

WELDING TIMER CORPORATION, Chrysler Bldg., New York City. Circular describing the advantages and applications of electro-mechanical welding timers.

Electric Furnaces

HEVI DUTY ELECTRIC CO., Milwaukee, Wis. Bulletin MU-1135, containing data on Alloy No. 10 high-temperature muffle furnaces for laboratory use.

Electric Welders

LINCOLN ELECTRIC CO., Cleveland, Ohio. Bulletins 309 and 310, giving specifications and information pertaining to engine-driven arc welders.

Arbor Presses

EDWIN E. BARTLETT CO., Nashua, N. H. Bulletin 60, illustrating and describing the new No. 60 hydraulic arbor press made by this concern.

Nails and Chaplets

ANGELL NAIL & CHAPLET CO., 4580 E. 71st St., Cleveland, Ohio. Combined text-book and catalogue on nails and chaplets.

Plating Equipment

UDYLITE CO., Detroit, Mich. Circular calling attention to the advantageous features of the Udylite plating barrel.

Non-Sparking Tools

SUPERHEATER CO., 60 E. 42nd St., New York City. Catalogue 20,001-1 on Elesco non-sparking tools.

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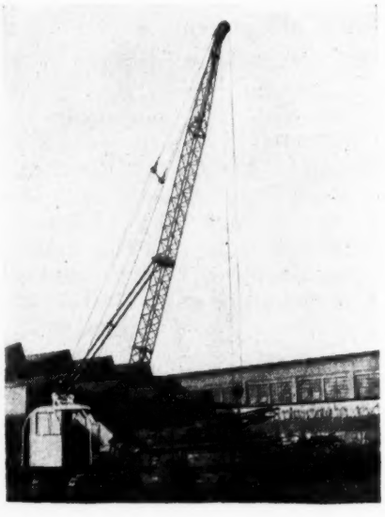
Training Supervisors and Key Men

A survey entitled "Training Supervisors and Key Men" has recently been published by the Policyholders' Service Bureau of the Metropolitan Life Insurance Co., New York City. This survey presents an outline of the methods used by eighty-five companies that have inaugurated such training programs. An analysis of the training methods used by these eighty-five companies shows that there are three predominating objectives: (1) To provide foremen with an opportunity to acquire information; (2) to help them to think clearly about their jobs; and (3) to develop their ability. The essentials for success in a program of foremen training, according to the report, are active interest on the part of the management, a competent leader, a carefully selected group, and practical subjects for discussion. The report also discusses the methods of the training program and the cost of conducting it. The details of the practice of seven companies are outlined at some length.



A Crawler Crane Weighing Less Than 15,000 Pounds Carrying a 50-foot Boom—Double the Length of the Standard 25-foot Boom. This is Made Possible by Using a Light, Welded Tube Construction. The Crane Was Built by the Harnischfeger Corporation, Milwaukee, Wis., for the Bahrein Petroleum Co., Ltd.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Reed-Prentice Brass Die-Casting Machines

Two machines for the die-casting of brass are being introduced on the market by the Reed-Prentice Corporation, Worcester, Mass. The larger of the machines, which is the one illustrated, exerts a pressure of 50,000 pounds per square inch on the metal being cast, with an oil pressure of 2000 pounds per square inch. The smaller machine applies a pressure of 10,000 pounds per square inch with an oil pressure of 1000 pounds per square inch.

In the operation of these machines, it is intended that the metal to be cast be first melted in an electric furnace or cupola and then transferred to a small furnace adjacent to the die-casting machine. The metal should be held in this furnace at a constant temperature that will keep it just beyond the plastic state.

Each time that the moving die is closed against the stationary die by actuating lever *A*, Fig. 2, the operator ladles a quantity of molten metal into the pouring slot on the upper side of cylinder *B*. He then depresses a foot-pedal, which operates a valve for applying pressure on the molten metal through plunger *C*. This plunger forces the metal into the die cavity with rapidity and great force. The forward stroke of the plunger is actuated by oil from an accumulator which is charged with nitrogen and maintained at the desired pressure by a pump on the machine. The capacity of the accumulator is such that there is only a 5 per cent drop in the hydraulic pressure as each "shot" is made. The accumulator can be seen at the right-hand end of the machine in Fig. 1.

Hydraulic heads for inserting cores in dies and for withdrawing them at the end of each operation can be mounted on both sides of the machine and also vertically at the top and bottom, as seen in Fig. 1. The foot-pedal for operating the plunger is electrically interlocked with the moving die-plate, so that it cannot be depressed until the dies are completely closed. The act of depressing the foot-pedal

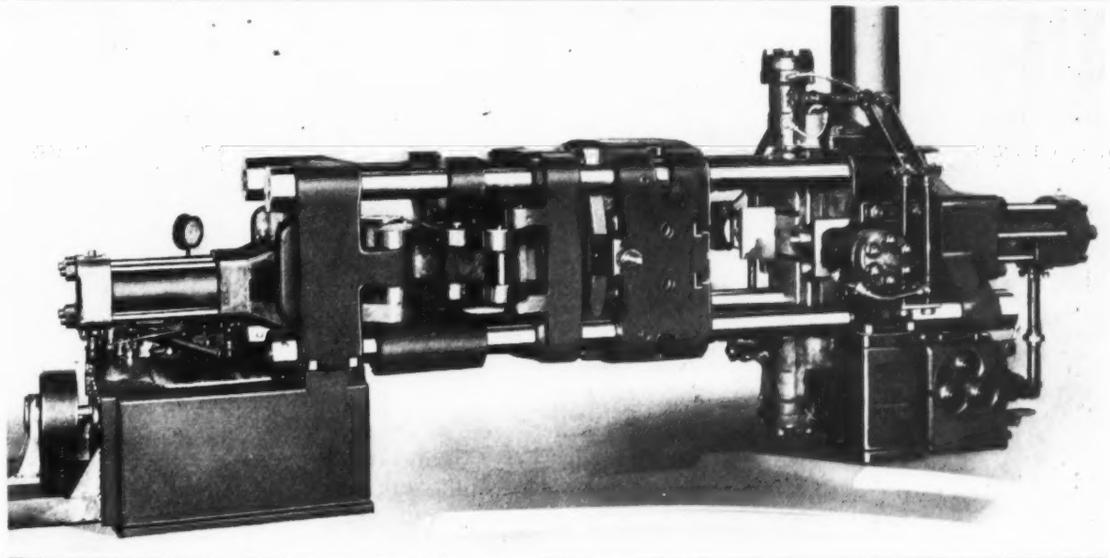


Fig. 1. Brass Die-casting Machine Brought out by the Reed-Prentice Corporation, which Applies a Pressure up to 50,000 Pounds per Square Inch

starts the rotation of three dials on panel *D*. These dials are fitted with dogs on the inside which actuate pilot valves. The pilot valves control main valves which admit oil under pressure into the various cylinders of the hydraulic system. The dials are graduated in seconds and can be adjusted in relation to each other for obtaining the desired timing of the various movements.

From the time that the operator steps on the foot-pedal, the operation is automatic. At a predetermined time, after the plunger has advanced, the cores are withdrawn from the dies and the dies then open. The plunger at first follows the moving die, pushing the sprue or gate metal from the stationary die, and then returns to its starting position. If the die-casting remains in the moving die, it is ejected at the end of the opening stroke. The dials of panel *D* reset themselves at the end of each operation. The cores are advanced into the dies when the moving die is closed.

The toggles that actuate the moving die do not abut against the die-plate proper, but against an auxiliary plate. This auxiliary plate is always in the same position at the end of the closing stroke. However, there is an adjustment between it and the die-plate to suit dies of various thicknesses. Adjustments are made by means of the shaft seen projecting from the side of the die-plate. When this shaft is turned, worm-gearing actuates two large-diameter screws which form the connection between the auxiliary plate and the die-plate. The lower of these screws may be seen in Fig. 1 just below the toggles, while the upper screw is hidden behind the tie-bar. The moving die-plate is a hollow steel casting designed for water cooling. The plunger is also arranged to be cooled with water.

The smaller of the two die-casting machines, which is known as the 2-G, has a space of 18 by 21 inches between the tie-bars and is equipped with die-plates measuring 32 by 37 inches. This machine has a die opening of 12 inches, a maximum die space of 24 inches, and weighs approximately 12,700 pounds. The larger machine—the 8-G—has a space of 20 by 22 inches between the tie-bars and is equipped with die-plates measuring 39 by 42 inches. This machine also has a die opening of 12 inches, but has a maximum die space of 17 inches. The movable die-plate can be adjusted 12 inches. The weight is approximately 23,500 pounds.

Niagara "Master Series" Press

A No. A-4 press of the inclinable open-back type has been added to the Master Series of the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. This press has a 4-inch diameter forged and ground main shaft. The press follows the same general design as other sizes in the Master

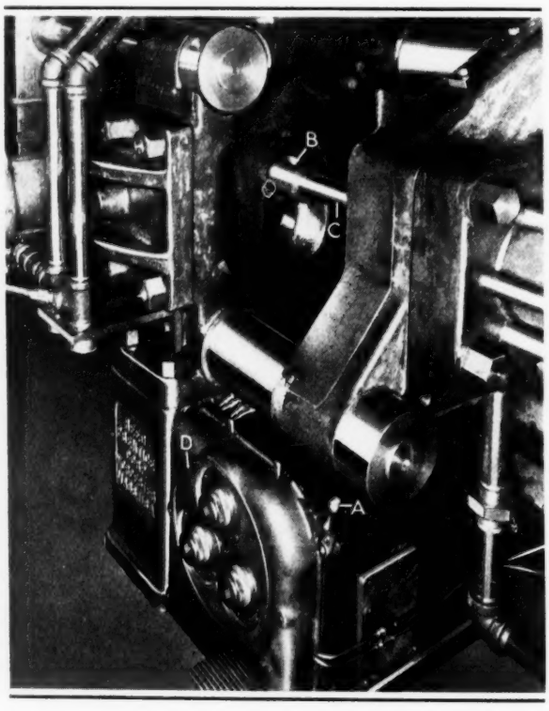
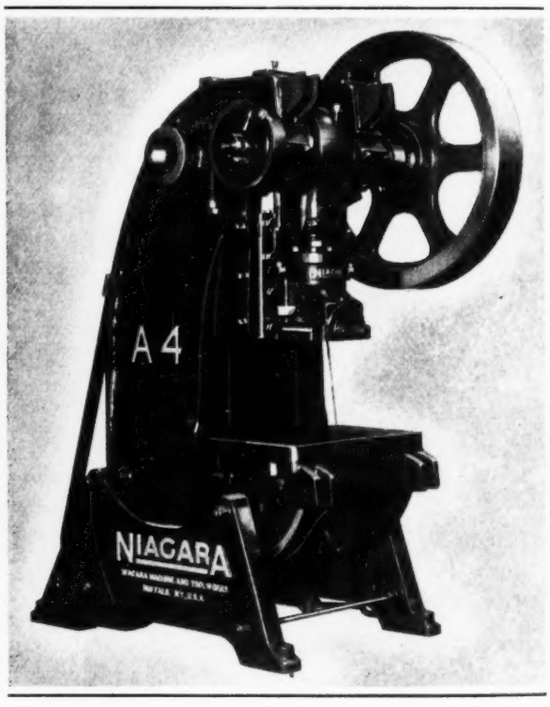


Fig. 2. View of Reed-Prentice Die-casting Machine Showing the Metal Cylinder, Plunger, Starting Lever, and Timing Dials



Inclinable Press with 4-inch Shaft, which has Recently been Added to the Master Series of the Niagara Machine & Tool Works

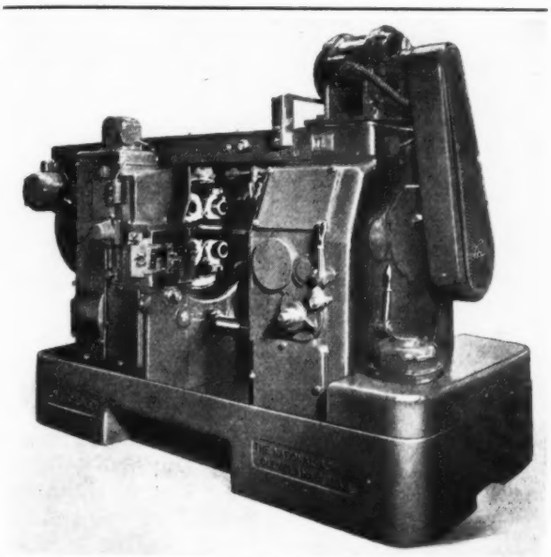


Fig. 1. Loading Side of the National Acme Model RP Chucking Machine

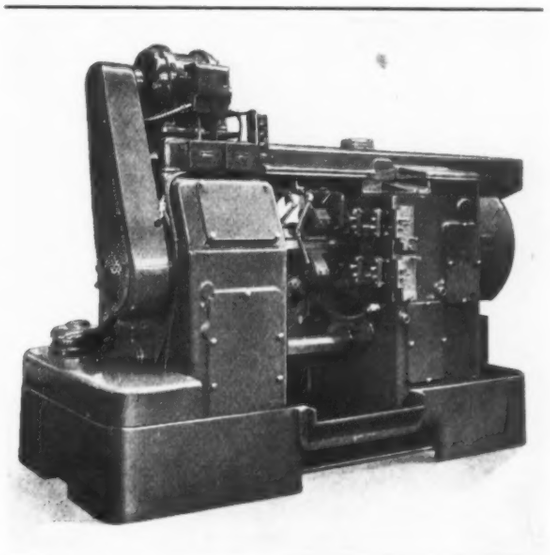


Fig. 2. Rear View of Chucking Machine, Showing Two Independent Cross-slides

Series which have previously been described in MACHINERY.

The construction includes a quick-acting six-point engagement clutch, a new type of slide, double-vee gibs, a self-contained anti-friction back-gear, a compensating brake, and a one-man inclining device equipped with anti-friction bearings. The slide is furnished with a breech-block die clamp, and is so designed that the die is equally supported from the center to the front and from the center to the rear. The press is motor-driven.

National Acme Automatic Chucking Machines of Four- and Six-Spindle Types

Work up to 8 inches in diameter can be handled by automatic chucking machines of a new design which are being introduced to the trade by the National Acme Co., 170 E. 131st St., Cleveland, Ohio. These Model RP machines are available in both four- and six-spindle types. Work of this size is often heavy, and for that reason the machines are so designed that the operator can stand close to them as he loads work into the upper front position. The operator can put the work-piece into the chuck with his right hand without reaching away from his body. The center line of the spindle in the loading position is only 44 inches above the floor.

While the operator holds the work-piece in the chuck with his right hand, he can operate push-buttons with his left hand to open or close the jaws of the electric chuck. Electric chucking is accomplished with a simple torque motor designed for this service and built into the machine. Variations in the diameter of the work-piece do not affect the force with which it is gripped by the chuck, as the torque motor simply makes a few more revolutions to compensate for errors in work diameter. After a piece has been chucked, the operator, by depressing another push-button at his left, can make the spindle revolve independently of the main drive to make sure that the piece does not "run out."

While the operator is chucking a piece, the parts in the other spindles are being machined. At the end of each cycle the tools withdraw, and the feed is interrupted until the operator pulls a starting lever. Then the spindle that has just been loaded is automatically engaged by the main-drive motor and the spindle-carrier indexes into the next operating position.

A great deal of the work handled by machines of this type is cast iron, and on that account, the cross-slides have been mounted vertically to guard against chips and dust lodging on the guides. Each slide rests on hardened and ground alloy steel plates, and a taper gib is provided for quickly taking up any wear. In order to simplify the mechanism, the cross-slide cams and rollers are mounted directly behind the slides in such a way that a large number of levers, pins, and studs are eliminated. The tooling space of the machine is unusually accessible; there are no projections interfering with the free flow of chips and coolant into the pan, and each cutting tool is in plain sight.

To meet the requirements in machining steel forgings, the construction is unusually heavy. All castings are normalized before finish-machining, so as to avoid distortion. A pump furnishes oil through a filter to all portions of the gear section and to the headstock, including the

bearings for the forming slides. Another pump delivers coolant to all cutting tools.

In order to reduce set-up time, the machine is so designed that all cams are accessible by removing a few guards. There is a start, stop, and jog push-button station on each side of the machine for convenience in making set-ups.

The main slide is of the well-known Gridley type. It is accurately ground, so that the tool-holders can be clamped in any position and still be accurately aligned with the spindle. The main slide moves forward and backward on a heat-treated spindle-carrier stem, so that alignment is always maintained between the end-working tools and the spindles. The feed and speed change-gears are also readily accessible by removing a guard. All shafts are mounted in anti-friction bearings and run in a flood of oil.

Landis Pipe Threading Machine Arranged for Tightening Drill-Pipe Joints

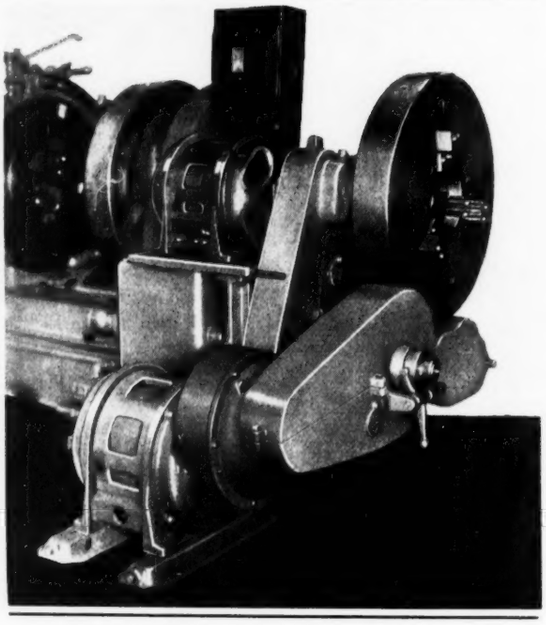
The increased use of threaded joints on drill pipe employed in the oil fields has brought a demand for equipment that will pull the threaded joints tight on the pipe. This operation, generally referred to as "bucking up" tool joints, is usually done on a pipe threading machine. However, the standard pipe threading machines have been found inadequate for this work because they are geared only for threading speeds. To overcome this difficulty, the Landis Machine Co., Inc., Waynesboro, Pa., has developed a dual speed arrangement for the pipe threading and cutting machine made by the concern.

This machine is regularly equipped with two motors operating at speeds of 1200 revolutions per minute. One motor provides spindle speeds through the gear-box ranging from 8 to 28 revolutions per minute for thread cutting, while the other motor has a geared head which provides a spindle speed of 2 revolutions per minute for tightening or "bucking up" the threaded joints of the drill pipe. The machine is equipped with a receding-chaser die-head.

A friction clutch is used for driving the machine at threading speeds, and a tooth clutch is employed for the slow speed. When either motor and its clutch is in operation, the other motor and clutch remain idle, separate levers being provided for engaging the proper clutch. A three-station push-button control is employed. One station is used to start the threading motor, the second station is used for the slow speed motor, and the third station for stopping the machine. The switch is wired to prevent starting both motors simultaneously.

Pease Continuous Blueprinting Machine

A blueprinting machine known as the Model 7 has been brought out by the C. F. Pease Co., 813-821 N. Franklin St., Chicago, Ill., to meet the growing demand for continuous printing equip-



Two-motor Drive Applied to Landis Pipe Threading Machine Used for Assembling Threaded Pipe

Pease Blueprinting Machine Designed for Continuous Operation or for Making Single Prints

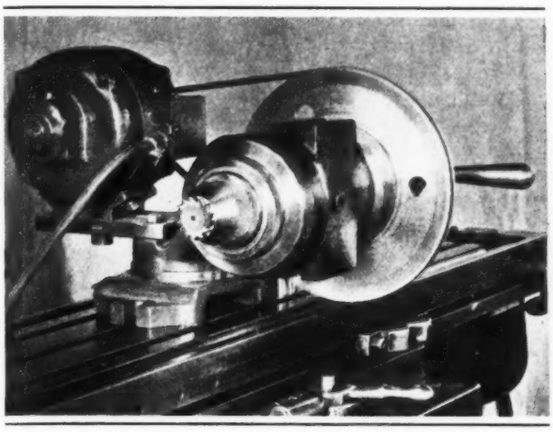


Fig. 1. Grinding a Woodruff Key Cutter Held in a New Chucking Mechanism Designed for Cincinnati No. 2 Cutter Grinders

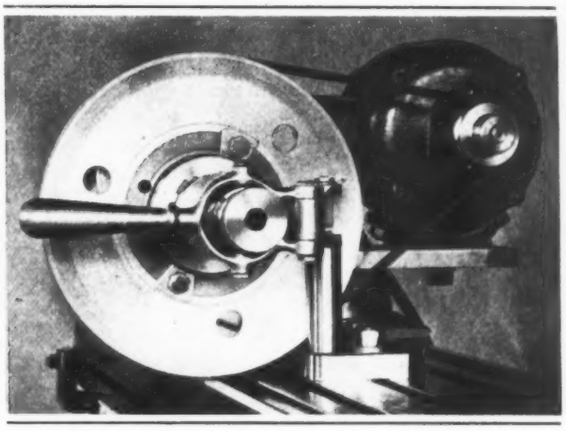


Fig. 2. View of the Work-head from the Right-hand End, Showing the Collet Opening and Closing Handle

ment of moderate capacity. This machine is designed to reproduce charts, diagrams, bulletins, etc., in a variety of forms, including blueprints, brown prints, or direct-process prints, in any dimensions up to 42 inches wide.

When operating continuously or when making single prints in cut sheet sizes, tracings and sensitized paper are fed into the machine at the front of the feed table and onto an endless fabric band which carries them through the machine in close contact with a curved section of highly polished plate glass.

After exposure, both the tracings and paper are returned to the tray at the front of the machine, where the tracings can be conveniently fed back into the machine if more than one print is desired. Provision is made at the front for holding a roll of paper 100 yards in length.

Uniform illumination is provided by three 50-inch mercury vapor tubes. When equipped with three of these tubes, sufficient illumination is provided for a printing speed of 2 linear feet per minute, while four tubes will give a printing speed of 2 1/2 feet per minute. An extension cord is provided for connecting the machine to any electrical circuit of 20 amperes capacity not exceeding 110 volts, alternating or direct current. The machine can be furnished on order for 220-volt current.

Chucking Mechanism for Cincinnati Cutter Grinder

Production rates in grinding Woodruff key cutters on the No. 2 cutter grinder manufactured by the Cincinnati Milling Machine Co. & Cincinnati Grinders, Inc., Cincinnati, Ohio, have been increased 100 per cent by the use of a quick-acting chucking mechanism recently designed by the concern. With this mechanism the rotation of the work-head does not have to be stopped to change the cutters. One hundred pieces can be ground per hour.

The mechanism consists mainly of an adapter collet with a tapered flange at the front that fits the National Standard nose in the work-head of the machine. The front adapter is pulled into the head by means of a lock-nut at the rear. At the same time, the rear end of the mechanism is also pulled into the work-head by a tapered adapter at the rear.

The handle and link seen in Fig. 2 are the conventional screw machine split-collet operating arrangement. A support for this handle and link is bolted to the table of the machine as close as possible to the work-head, allowing clearance for the aluminum pulley which drives the head. Several collets with different sizes of holes can be used in this attachment. The shank of the knurled knob at the rear end screws into the split collet, pulling it into place and holding it firmly. Opening and closing of the collet are effected independently of this adjustment by operating the handle.

In using this equipment, the first operation is to grind the back face of the Woodruff key cutter. For this operation, use is made of a collet having an end-stop that limits the distance that the stem extends into the collet, the back cutter face being held about 1 inch from the collet nose. Thus there is sufficient space to permit the grinding wheel to be applied to the back face of the cutter without interfering with the work-head spindle nose or the collet. After a quantity of cutters have been ground in this operation, another collet is substituted that permits the ground back face of the cutters to be seated against the collet, as seen in Fig. 1. As previously mentioned, the cutters are put into the collet and removed while the chucking mechanism revolves.

Southwark Plate Planer with Electric Feed

Two electrically fed 36-foot plate planers have recently been completed by the Baldwin-South-

wark Corporation, Philadelphia, Pa., for the Philadelphia Navy Yard. These are the first plate planers to be equipped with electric feeds. In other respects, they are the same as the heavy-duty plate planer described in January, 1935, MACHINERY, page 305.

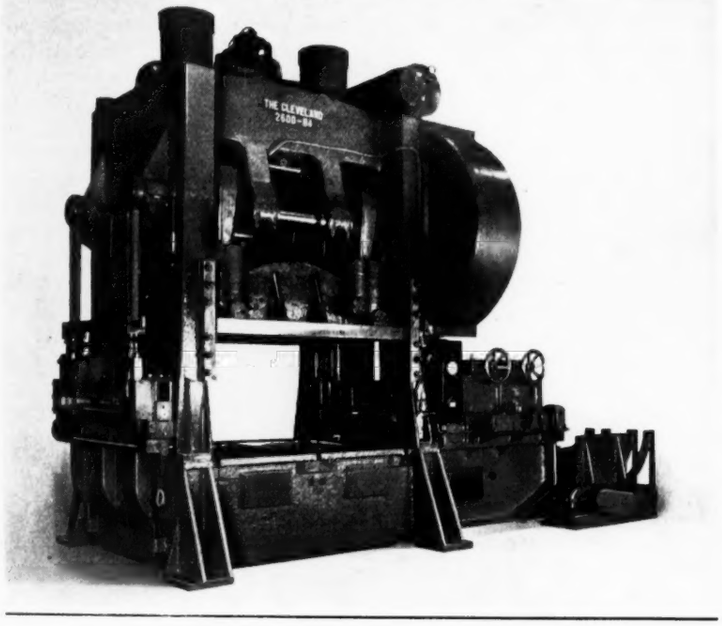
The carriage slides smoothly along its brass gibs or "shoes" at a rate of feed which can be varied from 15 to 45 feet per minute. At these feeds, cuts 0.01 to 0.25 inch deep and up to 1 inch in width can be taken on heavy steel plates. The carriage reverses itself automatically at each end of the stroke. At each reversal, the tool is automatically fed to the predetermined depth.

Cleveland Four-Point Suspension Press

A four-point suspension press for blanking and forming operations has recently been brought out by the Cleveland Punch & Shear Works Co., Cleveland, Ohio. Instead of the customary single shaft with two connections, this press is designed with two shafts having two connections on each shaft, one connection being located near each corner of the slide. This arrangement, in conjunction with extra long gibs and other features, maintains accurate alignment between the slide and the bed, regardless of whether the work is in the center of the bed or off center. With this construction, there is little possibility of the dies overlapping. The press can be furnished in any size.

The press illustrated has an electrically controlled, air-operated friction clutch and brake, and is equipped with self-contained pneumatic draw cushions which are located in the machine bed. The slide is air-counterbalanced. The air supply for all the pneumatic units is furnished by a compressor mounted on top of the press, thus making the machine independent of the plant air supply.

A double roll feed having supplementary rolls for leveling or straightening the material before it reaches the dies, and an automatic uncoiler are provided.



Cleveland Blanking and Forming Press Having Two Driving Shafts and Four Slide Connections

A scrap cutter is located on the opposite side of the press for shearing off the waste after a piece is blanked or formed. The feed and press operation are synchronized through an interlocking system which stops the ram in case the feeding arrangement fails to function properly.

While the rolls on this machine are regularly arranged to give any feed from 6 to 60 inches, they can be furnished to feed more or less, depending on the size of the machine and the operation.

Colt-Noark "Protectit" Switch for Overload Protection

A compact and simple device known as the Colt-Noark "Protectit," which functions as a manually operable switch with automatic overload protection, has been brought out by the Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. This switch is enclosed and can be mounted on the cover plate of an outlet box or directly on a wall. The regular casing is 3 1/8 inches long, 1 1/2 inches wide, and 1 1/2 inches deep, but special casings can be supplied.

The device has a maximum voltage rating of 250 volts alternating or direct current, in any of its ampere ratings, and a maximum horsepower rating of 1. A bimetallic strip serves as a mechanical latch which connects the switching member and its movable contacts with the handle. Overheating of the strip by the passage of an electrical overload causes it to bend sufficiently to release the switching member, thereby breaking the circuit. Two types are available, a Type BH having interchangeable heater elements, and a Type B which has a fixed ampere rating and cannot be changed. Nineteen different heater elements ranging from 1.3 to 14.2 amperes are available for use with the Type BH switch. Ten Type B switches are made which cover a range of capacity ratings from 1.3 to 15.0 amperes.

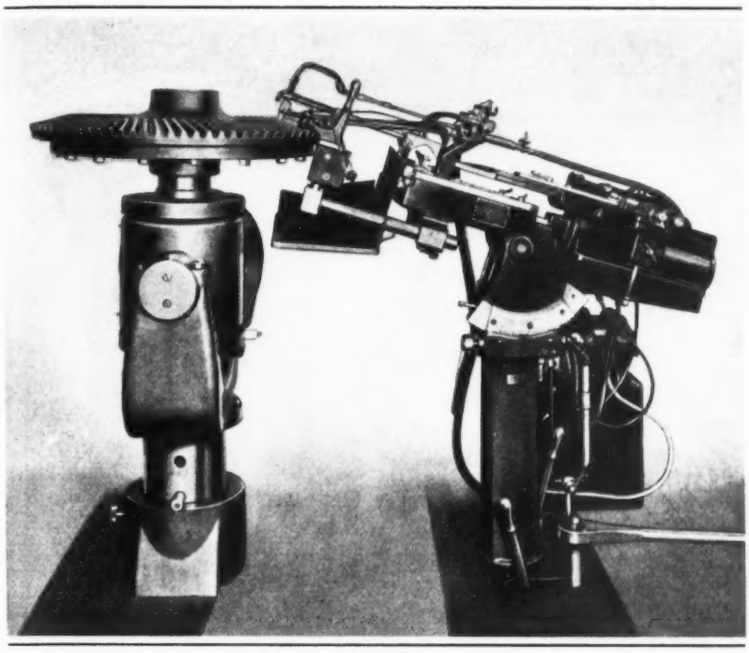


Fig. 1. Oxy-acetylene Flames are Employed in this Gleason Machine to Surface-harden the Teeth of Large Bevel Gears

Gleason Surface-Hardening Machine for Large Bevel Gears

Oxy-acetylene flames are utilized for surface-hardening the teeth of large bevel gears in a machine recently developed by the Gleason Works, 1000 University Ave., Rochester, N. Y. Gears up to 100 inches in diameter with teeth from 5 diametral pitch up can be accommodated with this equipment. Both sides of a gear tooth are hardened at one time by burners applied at opposite sides, as shown in Fig. 2. Quenching is accomplished by applying two small streams of water directly in back of the burners. Cumbersome tanks are not required.

The operation is entirely mechanical, except for indexing, and hence the human factor is eliminated. The machine is provided with a hydraulic control which permits a variable speed of travel. Thus a section of tapering thickness can be heated uniformly and the operation speeded up at both ends of the teeth, so as to prevent overheating of the corners.

The burners are carried by an upright which is adjustable toward and away from the work-head to suit various diameters of bevel gears. The work-head is stationary on the base, but the work-spindle unit can be swung on trunnions through an arc of 90 degrees. The burners are of simple design, the five pairs regularly supplied sufficing for practically all requirements.

The burner upright is raised and lowered by hydraulic pressure, and a safety clamp is furnished for locking it in the desired position. The burner unit is also provided with an angular adjustment. Both the forward and return strokes of the burner unit are independently adjustable for speed. The direction of travel of each burner is controlled by an adjustable guide. A small unit supplies the necessary hydraulic power.

Wearing surfaces having a hardness of Rockwell 55 to 60 or scleroscope 65 to 70 can be produced with this equipment. The penetration can be varied by adjusting the speed of the operation. It is recommended that the gears to be surface-hardened be castings or forgings containing 1.25 per cent manganese and 0.35 per cent carbon. When a steel of greater strength is required, specification S A E-6145 is recommended. Standard commercial cylinders of oxygen and acetylene are used with this machine, unless a more direct source of gas is available.

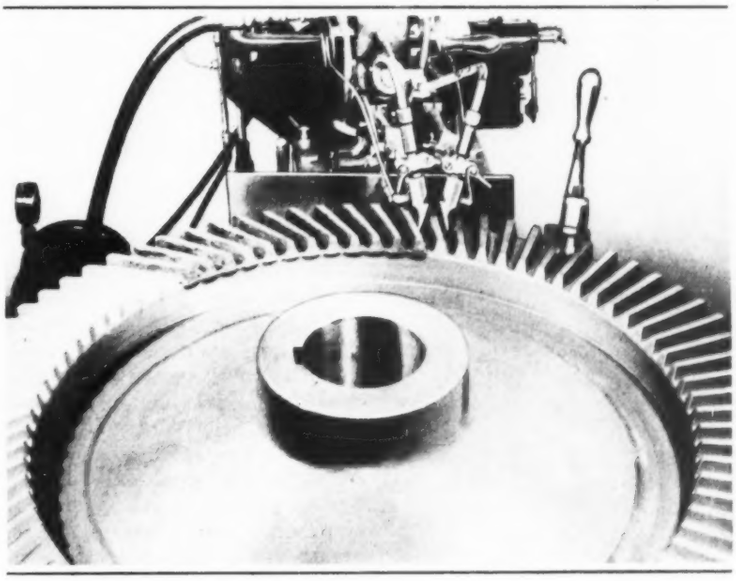
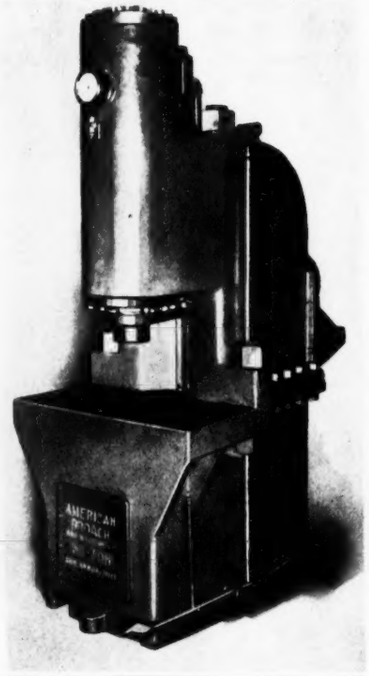


Fig. 2. Front View of the Two Oxy-acetylene Burners which Simultaneously Harden Both Sides of Gear Teeth

American Hydraulic Straightening Press

A hydraulic straightening press of 50 tons capacity, recently designed by the American Broach & Machine Co., Ann Arbor, Mich., is shown in the accompanying illustration. This press has an operating cycle consisting of a rapid ram advance at the rate of 104 inches a minute, a power pressure stroke at the rate of 23 inches a minute, and a rapid ram return at a speed of 142 inches a minute. Oil for the operation of the machine is contained in a reservoir located in the column. The hydraulic pressure is supplied by a two-stage pump which is driven by a 7 1/2-horsepower motor running at 1200 R.P.M.

Other important specifications of this machine are as follows: Stroke, 24 inches; height of table from floor, 32 inches; dimensions of table surface, 36 by 18 inches; diameter of ram, 6 inches; diameter of cylinder, 11 1/2 inches; and weight of machine, about 11,000 pounds.



American Hydraulic Straightening Press of 50 Tons Capacity

Farrel-Birmingham Hydraulic Press

A press designed especially for the molding of plastics and rubber, but which is adaptable to other work as well, is being placed on the market by the Farrel - Birmingham Co., Inc., Ansonia, Conn. This press is equipped with a self-contained hydraulic power unit which uses oil as the fluid medium. The press is of 100 tons capacity. It is equipped with platens that are 20 inches square. The opening between the platens is 12 inches.

A variable displacement pump and its driving motor are mounted on a steel plate over the top cross-head. In the cross-head is an oil reservoir. Steam- and oil-pressure gages are mounted in a white enameled depression on the front of the top cross-head behind protective shatter-proof glass. They are illuminated by indirect lighting.

Instead of the usual tie-rods between the top and bottom cross-heads, rolled steel slabs are used as tension members. These slabs fit machined tongues which project from the cross-heads. An adjustment is provided by means of tapered keys. The bottom cross-head is integral with the cylinder. Ventilated grids are interposed between the steam platens and the cross-heads to lessen the transfer of heat from the platens to the cross-heads. There are steam connections for the platens.

Farrel-Birmingham Press for Plastic and Rubber Molding

The operation of this press requires the opening and closing of only one valve. Adjustment of the maximum pressure of the variable displacement pump can be made through a handwheel on the pump. The appearance of the press follows the modern trend in industrial design. All enclosed parts are readily accessible.

G. E. Electric Motor- and Current-Controlling Equipment

Six new electric current-controlling devices have been brought out recently by the General Electric Co., Schenectady, N. Y. One of these developments is a line of manually operated transformer speed regulators for high- and low-torque capacitor motors. These regulators provide a total of seven reduced speeds and are available with and without full-voltage starting for single-phase motors up to 2 horsepower and polyphase motors up to 5 horsepower. For full-voltage starting, a relay is provided which automatically switches to the desired running position. The regulators are available for reversing service, as well as for operation from external sources, such as thermostats in air-conditioning systems.

Another new product is a master switch operated by a shipper rod which performs the function of a two-button momentary-contact push-button station. The magnetic contactor of this switch is designed to operate efficiently when the shipper rod is operated rapidly.

A low-voltage alternating-cur-

rent contactor which will stay closed through voltage disturbances or failures is another new product. This contactor is closed by a direct-current magnet, energized through a copper-oxide rectifier, and is held closed by the attraction of a permanently magnetized core and the movable armature. The permanent magnet is made of a new alloy called "Alnico," which was described in the Materials Section of January MACHINERY. This alloy retains its magnetism indefinitely. This device is free from the usual transformer hum experienced with alternating-current contactors.

A high-voltage alternating-current contactor employing the oil-blast principle of arc interruption and intended for use in completely oil-immersed motor controllers requiring moderately high interrupting capacity is still another new product. This contactor is rated at 200 amperes at 2200 to 4600 volts and will interrupt 50 000 kilovolt amperes.

A new line of combination magnetic switches with maximum ratings of 25 horsepower at 220 volts and 50 horsepower at 440 to 600 volts has also been developed. Air circuit-breakers which can be reset by hand after tripping are used. The breaker operating handle is interlocked with the enclosing case door, so that it cannot be opened when the breaker is closed. The breaker can be locked either open or closed from the outside of the case.

Another new product is a thermal-induction relay intended for use in oil-immersed motor controllers. This relay has tripping characteristics designed to eliminate difficulty in starting high-inertia loads at full voltage. The contacts, normally closed, have a slow opening action which prevents too quick tripping on overloads.

Fitchburg Spline-Shaft Grinder

The sides of splines on shafts and the root diameter of the shafts between the splines can be ground on a machine being introduced on the market by the Fitchburg Grinding Machine Corporation, Fitchburg, Mass. The sides of the splines and the space between the splines can be ground separately or a W-form wheel can be employed which grinds the sides of two splines and the space between them simultaneously. Straight or helical splines can be ground, the maximum helical angle, right- or left-hand, being 22 degrees. The maximum rotation of the machine for cutting helical splines is 250 degrees.

The headstock is motor-driven and is automatically indexed. It is also automatically rotated between indexings when helical splines are being ground. An index-plate to suit the required number of splines or a multiple-key index-plate which will accommodate two, three, four, six, eight, and twelve splines by means of inserts can be furnished.

The table is traversed hydraulically at a maximum speed of 30 feet a minute. The hydraulic control is built entirely in a panel attached to the front of the machine (see Fig. 1). The wheel-head is equipped with a ball-bearing spindle. This head may be driven by a motor mounted integrally with it or it may be driven through a V-belt by a motor mounted on the column. A truing device can be mounted on the wheel-head for

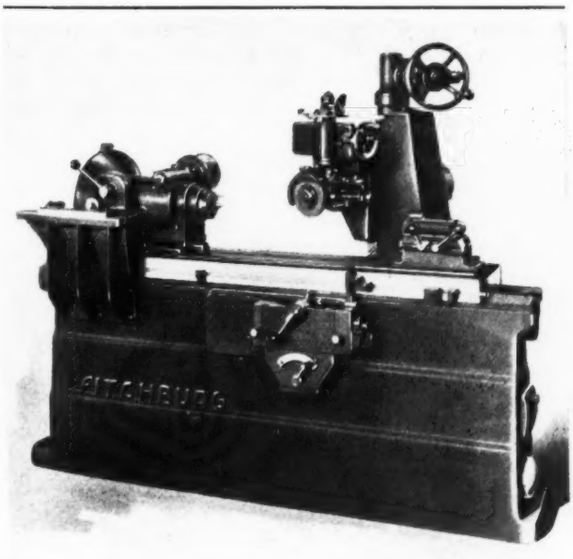
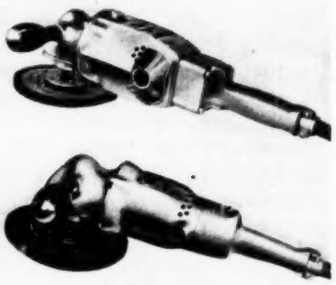


Fig. 1. Fitchburg Spline-shaft Grinding Machine with Hydraulically Traversed Work-table

Fig. 2. End View of Spline-shaft Grinder, Showing Wheel-head and Column, and Oil-pump Motor

dressing wheels of W-form. The footstock is adjustable both horizontally and vertically for aligning it with the headstock center.

The motor for the hydraulic unit is mounted on a separate base, as shown in Fig. 2, so as to prevent the transmission of vibration to the machine. The wheel-feed mechanism is mounted on the wheel-head column. There is a slow worm drive for feeding the grinding wheel, and a fast traverse for use in positioning the wheel-head.



Sanders Recently Brought out by the Black & Decker Mfg. Co.

Black & Decker Portable Sanders

A redesigned line of portable sanders which are more powerful than previous models, yet lighter in weight, has just been brought out by the Black & Decker Mfg. Co., Towson, Md. The new dustproof construction is designed to prevent grit from reaching vital parts of the motor or the gears and bearings. On heavy-duty and super-service models, the commutator and brush compartment is air-sealed and the switches are dustproof. New slot type exhaust ports reduce the danger of clogging and overheating the motor.

The four sanders in this new line are: A 7-inch light-duty sander for intermittent shop use in maintenance work; a 7-inch heavy-duty sander for continuous heavy work; a 7-inch super-service sander for continuous use on high-speed production work; and a 9-inch standard sander for use where a larger working area and lower speed are required for intermittent use. These sanders are all equipped with universal motors designed to operate on 110-, 220-, or 250-volt current.

Lenney Variable-Speed Transmissions

Variable-speed transmission units recently announced by the Lenney Machine & Mfg. Co., Warren, Ohio, are made in capacities of 1, 2, 3, and 5 horsepower. For an output speed of between 0 and 150 revolutions per minute, a motor running at 1200 revolutions per minute is furnished. For an output speed of between 0 and 200 revolutions per minute, a motor running at 1750 revolutions per minute is supplied. Either clockwise or counter-clockwise rotation of the output shaft is obtainable.

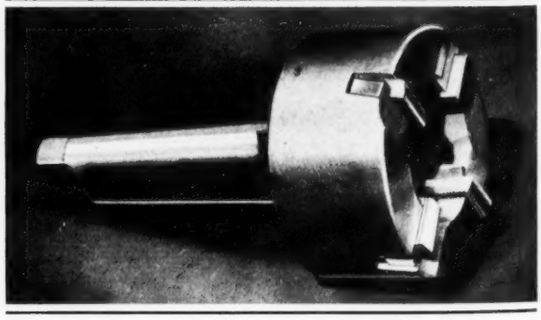
These variable-speed transmissions are based on the simple over-running clutch principle employed by the concern for several years. An illustration and description of these transmissions appeared in December, 1935, MACHINERY, page 287. The accompanying illustration shows a complete unit with self-contained motor drive.

Ingersoll Adjustable Zee-Lock Hollow-Mill

Inserted-blade adjustable hollow-mills of the design shown in the accompanying illustration have been added to the Zee-Lock line of tools made by the Ingersoll Milling Machine Co., Rockford, Ill. The inserted-blade cutters are held rigidly, but in such a manner that they can be adjusted to size. When completely worn out, the blades can be replaced.

The serrations that locate the cutter-blades are broached in the body of the tool, so that by reinserting the blades in the succeeding positions they will be moved forward and inward a few thousandths inch. This permits regrinding the cutters to size. The housing of the tool is ground accurately to the specified body diameter, so that the tool can be supported or piloted in a jig bushing or steadyrest. The cutter-blades may be of plain or super high-speed steel, J-metal, Stellite or cemented carbide, while the housing is a heat-treated alloy-steel forging.

Lenney Variable-speed Transmission Unit for Speeds up to 200 Revolutions per Minute

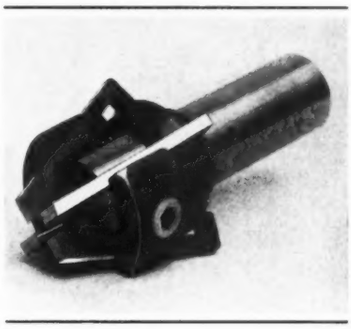


Hollow-mill with Adjustable Zee-Lock Blades Made by the Ingersoll Milling Machine Co.

Kutmore Adjustable Hollow-Mills

A line of high-speed adjustable hollow-mills designed for small automatic screw machines has been added to the regular line of milling cutters made by the Kutmore Tool Co., 841 Lake Ave., Rochester, N. Y. These hollow-mills are made very short in length, and are designed to combine light construction with the strength required to stand up under heavy cuts.

They are made in two groups of three sizes each. The three sizes in the first group are intended for the smallest machines and cover a range up to 1/4 inch. The second group of three mills is intended for larger machines, and covers a range of from 1/8 to 3/8 inch. The blades used in these mills are replaceable and are kept in stock.



Kutmore Hollow-mill for Automatic Screw Machines

Die-Heads for Cutting Taper Pipe Threads

A line of inserted-chaser die-heads developed for the purpose of cutting high-quality taper pipe threads has been brought out by the Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. These die-heads are so designed that the chasers recede at a definite rate until the proper length of thread is cut. The die-head then opens instantly, withdrawing the chasers from the work. The actual taper is governed by the positive action of the die-head, and is not dependent on the chasers. The chasers cut at the chamfer only, and thus leave no visible tool marks.

The taper action is obtained by means of a rotating opening cam placed between the backplate of the head and a knurled adjusting nut on the shank of the die-head. The angular position of this opening cam is determined by a plunger inside the shank of the die-head which, when pushed back by the work, rotates the opening cam at a predetermined rate. This rotating cam determines the length of the taper thread.

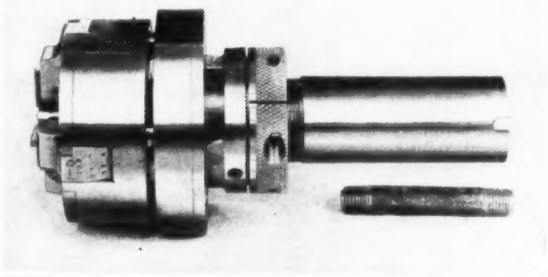
The rate of taper is fixed by the incline on the opening cam, and the final opening of the die-head is accomplished by a sudden drop in this cam. A fine adjustment for pitch diameter is provided. These die-heads can also be equipped with a reaming tool that will chamfer and ream the end of the pipe while the thread is being cut.

Whistler Adjustable Perforating and Notching Dies

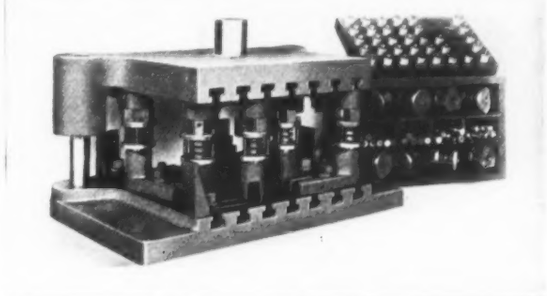
Dies with interchangeable perforating, notching, and stripping units which can be set to center distances as close as 1 1/2 inches are being made on a mass production basis by S. B. Whistler & Sons, Inc., 752 Military Road, Buffalo, N. Y. One of these dies, having a working surface of 12 by 12 inches, for example, is furnished with thirty-five punches and dies of various sizes; gages; twenty stripping units; and a case for the dies and units not in use, including five punch and die retainers.

A progressive perforating and blanking die for producing washers can be set up in about twenty minutes, using two standard punch and die retainers and a special die retainer. The stripper unit is designed to permit punching stock up to 1/8 inch thick and to strip the material from the punches. Corner notching dies of various shapes, which are adjustable for different depths of notches, are available.

When a group of holes, such as the four or five holes required in hinges are to be pierced, a cluster die can be provided, which can be moved along the T-slot in the die-bed to the desired position and clamped. The punches and dies are all held to a tolerance of 0.0002 inch. These dies are made in units as large as 48 by 60 inches.



Die-head for Cutting Taper Pipe Threads, Brought out by the Eastern Machine Screw Corporation

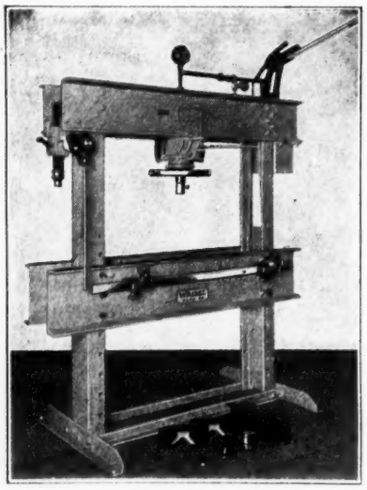


Whistler Adjustable Perforating and Notching Die with Interchangeable Units

Wright Hydraulic and Screw Presses

Hydraulic presses in 25-, 40-, and 60-ton capacities, and screw presses having capacities of 25 and 35 tons, have been brought out by the Wright Mfg. Division of the American Chain Co., Inc., York, Pa. The hydraulic presses can be operated from fifteen to twenty times faster than the screw presses. The screw presses use the same frames as the hydraulic presses, but a screw mechanism is used in place of the faster hydraulic equipment. Hydraulic pressure is built up by operating a lever with one hand.

With the hydraulic presses, it is an easy matter to obtain tremendous pressures with little effort, only two strokes of the pump being required to obtain a pressure of two tons. Pressure gages indicate the pressure exerted. After the work is completed, it is only necessary to turn a release valve to cause the ram to withdraw instantly from the work. An independent rack-and-pinion press is mounted at the left-hand side of both hydraulic and screw presses. With this arrangement, two men can work at one press at the same time.



Wright 60-ton Hydraulic Press

The open-side construction of both the hydraulic and screw type presses makes it possible to straighten long pieces. The distance between the lowest position of the table and the collapsed position of the screw and ram ranges from 37 to 45 inches in the different sizes. The 60-ton press illustrated is equipped with two hydraulic pumps, one of which is for fast work at moderately heavy pressures, and the other for extremely heavy pressures.

Acme Motor-Driven Pump

A "Sure-Flow" motor-driven pump having a capacity of 4 gallons per minute, intended for both high- and low-pressure service, has been added to the line of pumps made by the Acme Machine Products Co., Inc., Muncie, Ind. The low-pressure pumps are equipped with a 1/8-horsepower motor, while the high-pressure pumps are driven by a 1/3-horsepower motor. An adapter base for side-wall mounting is available.

These pumps are adapted for use where only a limited amount of coolant is desired, such as required for lathes or other single-spindle machine tools. This new pump is the smallest of eight sizes which cover a range of capacities from 4 to 100 gallons per minute.

"Do-All" Filing and Sawing Machine Equipped for Band Polishing

"Do-All" Machine Equipped for Band Polishing

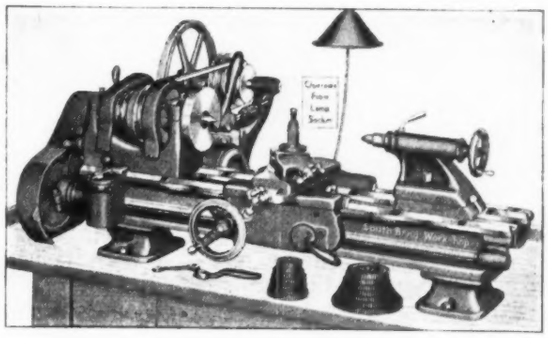
The combination band type filing and sawing machine made by the Continental Machine Specialties, Inc., 1301 Washington Ave., S., Minneapolis, Minn., which was described in November, 1935, MACHINERY, page 224, can now also be supplied for polishing. An endless band of emery cloth, mounted on the pulleys of the machine, permits continuous polishing and grinding by holding the work against the abrasive band, as shown in the accompanying illustration. The abrasive bands are made in the three different grits most commonly used in the shop for polishing.

The abrasive band is backed up by a rigid plate at the point where the work is applied. With this arrangement, rough, fast grinding or fine polishing operations can be performed. The infinitely variable speed arrangement makes it possible to use the correct speed for each operation.

Acme Motor-driven Pump Having a Capacity of 4 Gallons a Minute

South Bend 9-Inch "Workshop" Lathe with V-Belt Drive

The 1936 model 9-inch "Workshop" precision lathe made by the South Bend Lathe Works, 719 E. Madison St., South Bend, Ind., which was described on page 283 of MACHINERY, December, 1935, can now be obtained with a V-belt drive in place of the standard flat-belt drive, if desired. This V-belt motor-driven lathe has a four-step cone head-stock with a single V-belt drive from the countershaft. Eight spindle speeds are available, ranging from 44 to 585 revolutions per minute.



South Bend "Workshop" Lathe with V-belt Drive

The countershaft also has a four-step V-pulley for the single V-belt drive. Provision is made for releasing the belt tension to permit shifting the belt from step to step. A twin-gear reverse for right- and left-hand threads and feeds, a ball thrust bearing on the headstock spindle, and large spindle bearings are features of this new model. The bed is cast of 50 per cent steel and 50 per cent nickel iron. Bed lengths of 3, 3 1/2, 4, and 4 1/2 feet are available.

Stupakoff Comparator Microscope for Toolmakers

A comparator microscope intended for making accurate measurements of tools, dies, and finished products, and also for checking purchased articles to see that they meet the specifications, is manufactured by the Stupakoff Laboratories, 6625 Hamilton Ave., Pittsburgh, Pa. This instrument consists of a 60-power microscope equipped with an adjustable eye lens for focussing sharply on the cross-lines of the microscope field. Objects to be checked are fastened to a carriage which has a movement of 5 inches in one direction and 1 inch in the other. Means of illumination are incorporated, so that measurements can be taken on opaque objects.

Measurements in one direction are read directly on a 2-inch micrometer dial in thousandths of an inch, and in the other from a vernier scale in hundredths of an inch. The frame assembly and carriage members are constructed of an aluminum alloy, and all other moving parts are of non-corrosive metals.

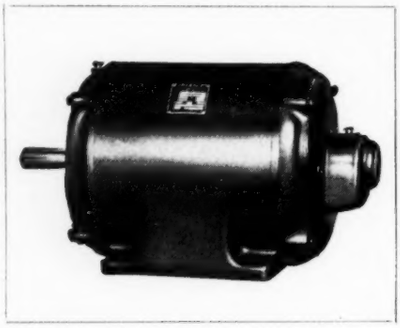
Comparator Microscope for Fine Measurements

Metallographic Polisher

A metallographic polisher employed in preparing specimens for measuring the thickness of plating has been developed by the Hanson-Van Winkle-Munning Co., Matawan, N. J., for use as a companion piece to the electroplater's microscope made by the Bausch & Lomb Optical Co., Rochester, N. Y. This polisher consists of a machine equipped with two fabric-covered wet polishing disks and a 4- by 36-inch belt set up with metallographic emery. The machine can be operated in either a vertical or a horizontal position.

To prepare a specimen, sections are sawed from the plated article and mounted on a clamp. The specimen is first filed with a coarse file, and then with a No. 2 pillar file to produce a surface that is sufficiently even for polishing. The specimen is then ground on the dry fine-emery belt, and next on the first disk, which is covered with duck. Fine emery suspended in water is applied to this disk with a camel's hair brush during the operation. Final polishing is done on the second disk, which is covered with broadcloth to which a suspension of levigated alumina is applied. After washing, drying, and in some cases etching, the specimen is ready for examination under the microscope.

The wet polishing disks are enclosed by adjustable cast-aluminum splash guards. The polishing cloths are held in place on the disks by a spring which fits into a groove in the periphery of each disk. This insures even tension on the cloths and true balance of the disks. The machine is driven by means of a 1/3-horsepower motor.



Emerson Single-phase Motor

Emerson Motor Designed for Smooth Starting

To meet the demand for a single-phase motor with a smooth starting action for operating air compressors, commercial refrigerators, pumps, grinders, and other devices in which the starting load is heavy or in which the starting is greatly prolonged, the Emerson Electric Mfg. Co., St. Louis, Mo., has developed the Type SR motor here illustrated.

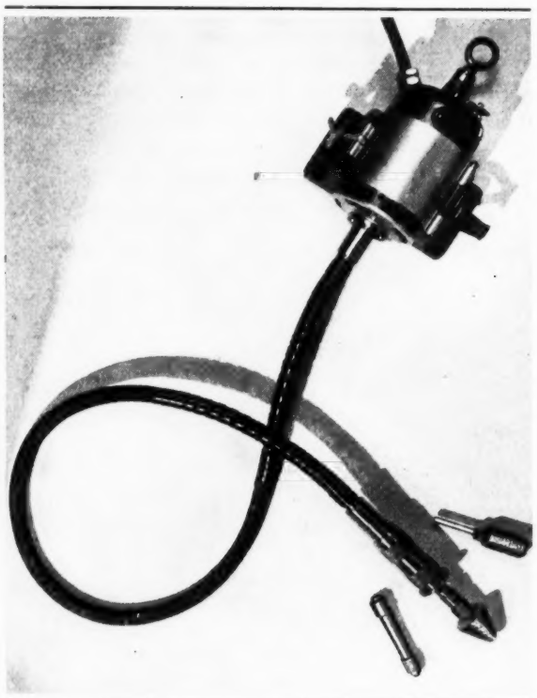
A squirrel-cage winding and a repulsion or commuted winding, both of which operate as such at all times, have been combined to obtain efficient starting features. This motor is designed to run at a speed of 1725 revolutions per minute, and is now available in 1, 1 1/2, 2, and 3 horsepower sizes.

"Speedwitch" Flexible-Shaft Grinder

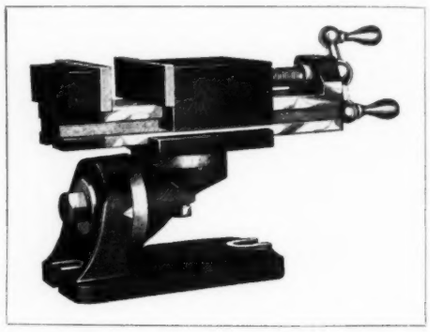
A flexible-shaft grinder designed primarily for high-speed grinding with standard or profile wheels up to 2 inches in diameter, which can be used on steel dies, welds, and castings, has been brought out by the Charles L. Jarvis Co., Gildersleeve, Conn. Such tools as sanding drums and hard felt polishing buffs of small diameter, can also be used.

The 1/3-horsepower, 110-volt, ball-bearing, heavy-duty universal motor with built-in switch has a speed of 18,000 revolutions per minute. It is mounted in a combination bench and overhead suspension base with a hand-piece holder.

The Biax flexible shaft used is a Jarvis product, and is 1/4 inch by 42 inches long. It has a rubber reinforced casing with protection springs on each end. The hand-piece is equipped with precision ball bearings especially designed for high speed, and is furnished with a 1/4-inch collet.



Jarvis Flexible-shaft Grinder



Covel Universal Machine Vise

Covel Universal Machine Vise

A horizontal universal vise designed to permit locating work at any predetermined angle in both the horizontal and vertical planes has been developed by the Covel Mfg. Co., Benton Harbor, Mich. One of the features of this vise, as shown by the accompanying illustration, is the amount of clearance space at the sides and end of the vise jaws.

The top part of the vise is fastened to a universal bracket with a T-slot bolt, and can be quickly removed, adjusted, or reversed. All surfaces are accurately ground to obtain squareness, and the bracket is accurately graduated in degrees to facilitate locating the work in any position desired. Angle adjustments are locked by hardened nuts. The vise can be used on a surface grinder, milling machine, drill press, or shaper. Normal cuts can be taken without moving the work or changing adjustments.

The vise has a capacity of 4 inches when the hardened steel jaws are in place, and 5 inches when the jaws are removed. The jaws are 4 1/2 inches wide by 1 1/2 inches high. The base is 4 1/2 by 8 1/4 inches. The weight is 36 pounds.

* * *

Orders received by the General Electric Co. in 1935 amounted to over $217,000,000, as compared with $183,000,000 in 1934.

NEWS OF THE INDUSTRY

Connecticut

ROBERT B. SKINNER has resigned his position as secretary-sales manager of the Skinner Chuck Co., New Britain, Conn., to become vice-president and general manager of the D. E. Whiton Machine Co., New London, Conn. The latter

Robert B. Skinner, Vice-President and General Manager of D. E. Whiton Machine Co.

company manufactures chucks, centering machines, gear-cutters, castings, and steam turbines. Mr. Skinner has been engaged in the chuck business ever since he left school, and has been in contact with all phases of manufacturing and distributing in that business. He has also been active in trade association work, especially in the American Supply & Machinery Manufacturers Association, having served as a member of many important committees. In 1927 he was president of the organization.

K. H. WALTHER has been appointed secretary and sales manager of the Skinner Chuck Co., New Britain, Conn. Mr. Walther has been with the company since 1920, and for several years has been chief engineer. Mr. Walther's appointment is to fill the vacancy caused by the resignation of R. B. Skinner, who has accepted the position of vice-president and general manager of the D E. Whiton Machine Co., New London, Conn.

ALLEN-BRADLEY CO., 1331 S. First St., Milwaukee, Wis., manufacturer of electric motor control equipment, announces the appointment of S. A. RHODES, 2015 Main St., Cromwell, Conn., as representative of the company in the Connecticut territory, succeeding R. B. SODERBERG, of Hartford.

WHITNEY MFG. CO., Hartford, Conn., manufacturer of roller, silent, block, and conveyor chains and sprockets for the last thirty-five years, has changed its corporate name to the WHITNEY CHAIN & MFG. CO. No change in company policy or product will be involved.

W. R. G. BAKER has been appointed managing engineer of the radio receiver section of the General Electric Co., at Bridgeport, Conn. For the last few years Mr. Baker has been connected with the RCA-Victor Co. of Camden, N. J.

Illinois and Indiana

DETROIT REX PRODUCTS CO., 13006 Hillview Ave., Detroit, Mich., announces the opening of a new branch office at 201 N. Wells St., Chicago, Ill., to cover the states of Wisconsin, Illinois, and Missouri. The representatives in charge of this territory are G. P. ANSTISS, S. B. CROOKS, and G. L. JUNG. FRANK P. COX, who will make his headquarters at Detroit, will supervise the sale and service of Alkali cleaners throughout the country. GEORGE W. WALTER, formerly editor of *Metal Cleaning and Finishing*, has been appointed advertising manager.

QUICKWORK CO., manufacturer of rotary shears, power hammers, and other metal-working machinery, announces the removal of the company from St. Marys, Ohio, to a new plant at 900 N. Spaulding Ave., Chicago, Ill. In addition to the company's regular lines, it is now building welded-steel press frames, welded-steel columns for power hammers, and other welded-steel assemblies.

R. L. MEAD has been appointed manager of the Chicago office at 20 N. Wacker Drive of the Harnischfeger Corporation, Milwaukee, Wis., manufacturer of cranes, hoists, welders, motors, etc. Mr. Mead was recently district sales manager with the Link-Belt Co.

INLAND STEEL CO., Chicago., Ill., has started on a construction program involving the installation of four new open-hearth steel furnaces and a blooming mill. This equipment will replace older equipment that has become obsolete.

ILLINOIS GEAR & MACHINE CO., 2108 N. Natchez Ave., Chicago, Ill., has purchased all of the machinery and equipment of the William Ganschow Co. Division of Gears and Forgings, Inc., in Chicago.

AMERICAN FOUNDRY EQUIPMENT CO., 555 Byrkit St., Mishawaka, Ind., announces that it has added a large building to its plant for assembly and shipping purposes, in order to meet the increasing demand for the American Wheelobrator, as well as other products of the company.

Michigan

COGSDILL MFG. CO. is making additions to its plant at 6511-15 Epworth Blvd., Detroit, Mich. These consist of an additional story on the front part of the plant for office purposes and an extension for manufacturing purposes, adding a total of nearly 4000 square feet to the available floor area. The extension will be devoted especially to the manufacture of bearing-izing machines and tools, for which there has been an increasing demand.

DEL S. HARDER, who up to the present time has been on the staff of Thomas P. Archer, vice-president of the Fisher Body Corporation in charge of operations, has been made resident manager of a new plant to be constructed for the Grand Rapids Stamping Division of the General Motors Corporation. The expenditures for this new plant may eventually exceed $7,000,000. It will be operated by the Fisher Division of General Motors.

MICHIGAN TOOL CO., Detroit, Mich., has completed an extensive addition to its plant on Six Mile Road, Detroit. The new plant, made necessary by the increasing demand for the company's products, will be devoted mainly to the building of machine tools, including gear-finishing and lapping equipment, gear-testing machines, checking fixtures and other types of machines built by the company.

RAY MACK has been transferred from the Detroit, Mich., office of the Carboloy Company, Inc., manufacturer of Carboloy cemented-carbide tools and dies, to the Chicago district office. J. C. KENT, of the Detroit district office, will be added to the sales force covering the southern Michigan territory. J. E. WELDY, Minnesota representative, will join the Detroit district office as assistant to the sales manager.

GODDARD & GODDARD CO., INC., Detroit, Mich., manufacturer of milling cutters, has appointed H. F. REUTER, 16905 Hilliard Road, Cleveland, Ohio, representative of the company in the northern half of the state of Ohio. E. G. DORAN, 1618 W. Fulton St., Chicago, Ill.,

will represent the company in the state of Iowa, the northern half of Illinois, and the northwest corner of Indiana.

ALLEN-BRADLEY CO., Milwaukee, Wis., announces the removal of its Grand Rapids, Mich., sales office to 410 Houseman Bldg.

Minnesota

BENJAMIN C. BRADFORD, who has been district sales manager of the Inland Steel Co.'s St. Paul, Minn., office for the last thirty-two years, has resigned and will be succeeded by ERVIN J. SANNE. Mr. Sanne has been associated with Joseph T. Ryerson & Son, Inc., since 1917 and has been in the sales department of that company in the Chicago district since 1921.

DAVID S. WRIGHT has joined the sales department of the Inland Steel Co.'s St. Paul, Minn., office. Mr. Wright was formerly at the Indiana Harbor Works of the company in the department of inspection and metallurgy.

New York and New Jersey

TRIPLEX MACHINE TOOL CORPORATION, 125 Barclay St., New York City, American agent for the Swiss jig boring machines made by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, has appointed the following agents: JEFFERY-GILLES, INC., Cleveland, Ohio; BARNEY MACHINERY CO., Pittsburgh, Pa.; W. E. SHIPLEY MACHINERY CO., Philadelphia, Pa.; H. A. SMITH MACHINERY CO., Syracuse, N. Y.; F. W. SCHIEFER MACHINERY CO., Rochester, N. Y.; GALVIN MACHINERY SALES, Buffalo, N. Y.; and MARSHALL & HUSCHART CO., Indianapolis, Ind.

THOMAS N. ARMSTRONG, JR., has joined the technical staff of the International Nickel Co., Inc., 67 Wall St., New York City. Mr. Armstrong will have charge of the steel castings development for the company and will make his headquarters in New York. He was formerly associate metallurgist at the Norfolk Navy Yard, Portsmouth, Va.

TOLEDO SYNTHETIC PRODUCTS, INC., Toledo, Ohio, announces that the name of the company has been changed to PLASKON CO., INC. There will be no change in the personnel or management. New York offices have been opened at 41 E. 42nd St., New York City.

CHARLES G. DURFEE has been appointed assistant to the vice-president in charge of sales of the Pyrene Mfg. Co., Newark, N. J. Mr. Durfee has been associated with the company for eight years, the last four years having been manager of the systems department.

Ohio

R. C. BROWER, secretary-treasurer of the Timken Roller Bearing Co., Canton, Ohio, was elected a director at a special meeting of the board of directors, to fill the vacancy caused by the recent death of J. G. OBERMIER. Mr. Brower joined the Timken organization in 1916 as assistant manager of the Timken Service & Sales Co., later becoming manager. He was then appointed assistant secretary-treasurer of the Timken Roller Bearing Co., being made secretary-treasurer in 1930.

GEOMETRIC TOOL CO., New Haven, Conn., announces the appointment of JEFFERY-GILLES, INC., Caxton Building, 812 Huron Road, Cleveland, Ohio, as exclusive agent for Cleveland and vicinity. The company will carry a stock of Geometric chasers and tools for prompt service in Cleveland. P. A. PRITCHARD, direct sales and service engineer for the Geometric Tool Co., will supplement the work of Jeffery-Gilles and make his headquarters with that concern.

D. P. HESS, who has charge of foreign operations for the Timken Roller Bearing Co., Canton, Ohio, sailed for Europe on the *Washington*, January 15, to spend six or eight weeks with the officials of the foreign companies associated with the Timken organization. Timken business in foreign countries has been increasing rapidly in railroad and rolling mill applications abroad, as well as in the industrial and automotive fields.

A. S. HELLSTROM has been appointed manager of the Cleveland, Youngstown, Akron, and Wheeling districts for the Torrington Co., Torrington, Conn., and its subsidiary, the Bantam Ball Bearing Co., of South Bend, Ind. His headquarters will be in the Caxton Bldg., Cleveland, Ohio.

REPUBLIC STEEL CORPORATION, Youngstown, Ohio, announces the removal of its Cleveland district sales office from the Union Trust Bldg. to 920 Republic Bldg., Cleveland, Ohio. W. E. Collier continues in charge as district sales manager. The general offices of the company are also being moved from Youngstown to Cleveland.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., announces the removal of its Cincinnati district sales offices to the Chamber of Commerce Bldg. W. G. May continues in charge as district sales manager.

Pennsylvania and Maryland

LADD EQUIPMENT CO., First National Bank Bldg., Pittsburgh, Pa., sales agent in the Pittsburgh Tri-state area for Poole flexible couplings, manufactured by the Poole Foundry & Machine Co., Woodberry, Baltimore, Md., announces that the entire state of Ohio, with the exception of the Cincinnati district, has been added to its sales territory. A district office will be maintained in the Rockefeller Bldg., Cleveland, with G. H. BALES in charge.

Frank W. Curtis, Manager of Firthite Division of Firth-Sterling Steel Co.

FRANK W. CURTIS has been appointed manager of the Firthite Division of the Firth-Sterling Steel Co., McKeesport, Pa. He will be in charge of engineering, sales, and product development of Firthite sintered carbides.

REVERE COPPER & BRASS, INC., 230 Park Ave., New York City, announces the consolidation of the Baltimore Division and the Baltimore Tube Co. Division of the company, which will hereafter operate as the Baltimore Division. The sales offices are located at 1301 Wicomico St., Baltimore, Md. R. S. STRINGER is vice-president, and R. H. HODGES sales manager of the Baltimore Division.

CALENDARS RECEIVED

UNITED ENGINEERING & FOUNDRY CO., Pittsburgh, Pa.

HYATT ROLLER BEARING CO., Newark, N. J.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa.

WATERBURY FARREL FOUNDRY & MACHINE CO., Waterbury, Conn.